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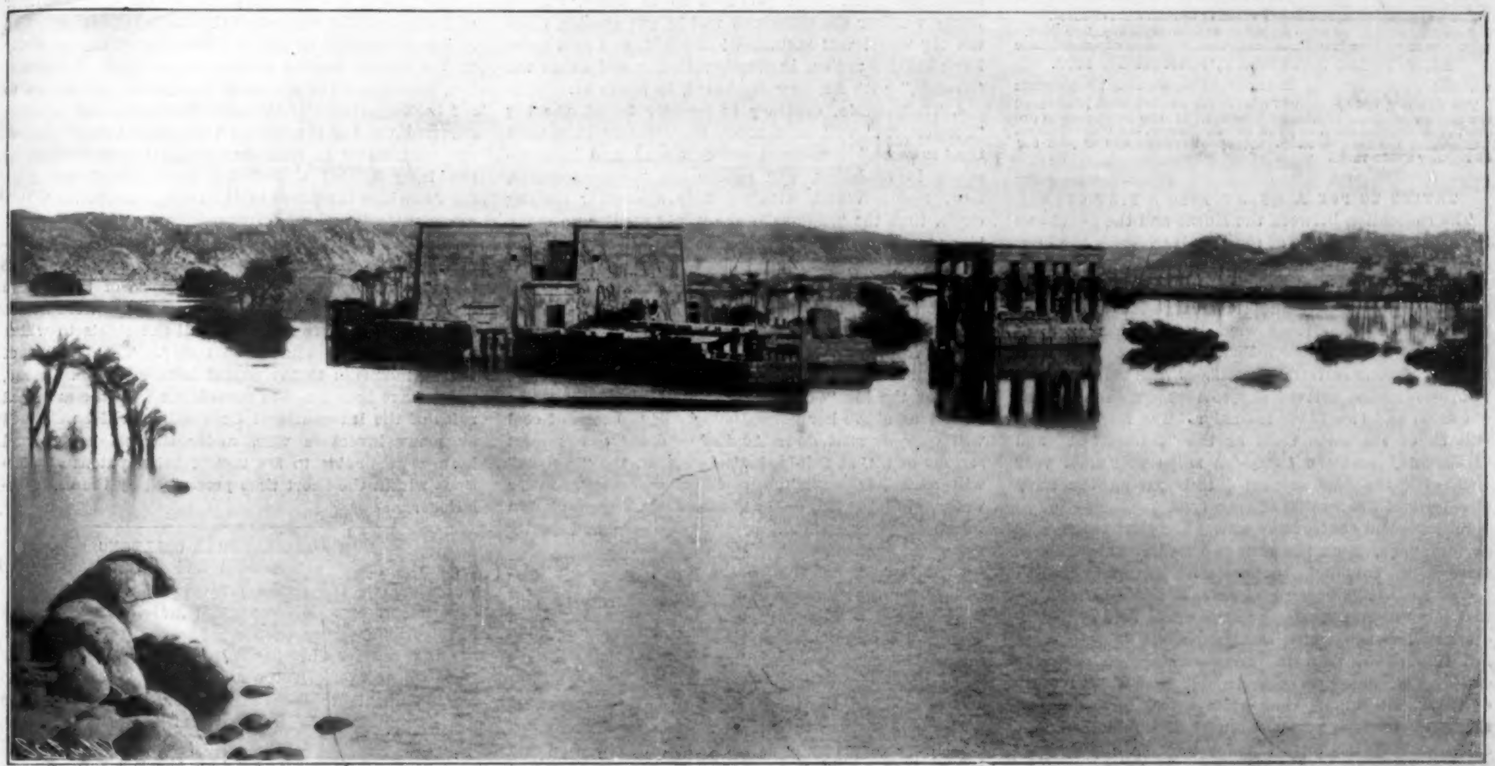

General View of the Ruins of Philae, Showing the Island Completely Submerged, the Temples only being Visible.

Submergence of the Island of Philae by the Dam at Aswan.

THE RESTORATION OF THE FOUNDATIONS OF THE PHILAE TEMPLES.—[See page 194.]

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NEW YORK, SATURDAY, MARCH 14, 1903.

The Editor is always glad t) receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

TRYING TO PUT A QUART INTO A PINT CUP.

The contention between the House and the Senate on the question of the size of the new battleships has been compromised in a manner which reflects great credit on the generosity of Congress and proves that it is fully alive to the necessity for a large increase in our naval power. The House wished to provide for three battleships of 16,000 tons displacement; the Senate was in favor of four battleships of 12,000 tons displacement. The compromise arrived at provides for three 16,000-ton ships and two 13,000-ton ships. The larger vessels will be of the same class as the "Connecticut" and "Louisiana," and the 13,000-ton ships will class very well with the "Maine" type, thus giving the navy two fleets of five vessels of each type.

In the recent controversy we see the recrudescence of an old fallacy, which has always caused, and always will, more or less trouble in the matter of battleship design; and of battleship design in general it may be truly said that there are no problems in the whole field of technical knowledge in which the layman can more quickly fall into error, than in those affecting the relative efficiency of warships. The trouble with the advocate of the small ship is that he seems to have an idea that it is possible to put a quart of liquid in a pint cup—that a given total tonnage may be divided into a number of numerous small units, each of which would represent individually as much fighting efficiency as would be secured if that same total tonnage were divided into a fewer number of units of much greater displacement.

Now, as a matter of fact, nothing could be farther from the truth. It is as well understood in the navy, as it is in the merchant marine, that the larger the ship the greater the efficiency per ton of ship. Why is it that merchant vessels are climbing up in size so rapidly that to-day they have reached the enormous displacement of 37,000 tons, as represented by the "Cedric" and "Celtic"? It is for the very good reason that each ton in the big vessel has a greater earning capacity than each ton in a smaller vessel; and the situation is strictly the same in the case of ships of war. Each ton of the 16,000 tons of the "Connecticut" represents vastly more fighting power than each ton of a 12,000-ton "Alabama;" and just here, by way of parenthesis, we may add that the theory of building many small ships with a view to covering our coast line is false, for the reason that in future wars battleships will never be scattered in isolated positions for the purpose of doing police duty. They will be gathered into fleets, and the fortunes of war will depend entirely upon the fortunes of these fleets. This is clearly shown in the series of war games which we are publishing week by week in the Scientific American Supplement.

All the navies of the world are steadily increasing the size of their battleships at each appropriation. Great Britain, indeed, whose very existence depends upon keeping her navy in a state of the highest efficiency, is this year providing for the construction of three great vessels of 18,000 tons displacement, or 2,000 tons more than that of the large vessels we have just authorized. This in itself is a most potent argument, when we consider the vast interests at stake, against a return on our part to small battleships of the second-class size. Having said this much, perhaps the best way to consider the subject is to present the arguments in favor of the big ship categorically and as briefly as possible.

1. In the large ship there is a gain in effective battery power. The weight of one round from the 12,000-ton "Alabama" is 5,312 pounds, and from the 16,000-ton "Connecticut" 7,856 pounds. Hence, for an increase of one-third in size, there is a gain of about one-half in effective battery power, or $30,000,000 will give us four "Connecticuts" of a battery power of 6, or five "Alabamas" of a relative battery power of 5.

2. The armor protection of the "Maine" is 2,770 tons, of the "Connecticut," 4,000 tons; an increase of protection of 44 per cent, for an increase in size of 33 per cent. This great gain in power of attack and defense is due to the fact that the big ship requires a smaller proportion of her weight to be given to hull and machinery than does the smaller one for the same power and speed; for, whereas in a 12,000-ton ship 4 tons of any 10 tons of weight must be devoted to the structure, leaving 6 tons for speed, battery, and armor, in 16,000-ton ships similar to the 12,000-ton, only 3¾ instead of 4 tons out of every 10 must be devoted to the structure, so that the weight available for the fighting elements of the vessel is not actually, but relatively, greater for the big ship.

3. In a comparison of the 10,288-ton "Oregon" and the 16,000-ton "Connecticut," we find that the contract speed has risen from 15 knots to 18 knots, and in heavy weather the difference will be yet greater, since the big vessel will maintain her speed, and cast loose her guns for action, in weather that would cause the "Oregon," with her low freeboard, to heave to.

4. Then, again, contrary to popular belief, the big "Connecticut" will be a much more handy ship than the "Indiana." Improved steering gear, and improvements in modeling, will render the "Connecticut" a more mobile vessel, with probably a smaller turning circle, than the "Indiana"—she would require no more, if as much, room in which to maneuver than the smaller vessels.

5. The "Connecticut" carries 2,200 tons of coal; the "Oregon" 1,600, and the radius of action of the larger ship is somewhat greater. To load up the small "Indiana" from her normal coal supply of 400 tons to her maximum supply will increase her draft by 28 inches, whereas the big "Connecticut" in taking on the extra 1,300 tons above her normal supply of 900 tons of coal will only be sent down 20 inches deeper; but most serious of all, at full-load displacement, the "Indiana" will sink her waterline belt armor entirely under water, while the belt of the "Connecticut" would remain where it always should be, partly above and partly below the waterline.

6. As regards fighting powers, the "Connecticut" carries 70 per cent more weight of guns and 90 per cent more weight of ammunition than the "Oregon;" and when we take account of the energy and rapidity of fire of the guns, we find that if all the guns on the battleships were engaged at full capacity for a period of five minutes, the total energy of the "Connecticut" would be 3½ times the greater.

7. In a comparison of defensive qualities, we find that the "Connecticut" carries 4,000 tons of armor against 2,900 tons carried on the "Oregon;" moreover, this greater weight of armor covers a relatively larger area. The belt extends, in the big ships, entirely from stem to stern, whereas in the "Oregon" it only extends over the middle two-thirds of the ship, while there is a total armored area on the sides of the "Connecticut" of 7,827 square feet as against 2,229 square feet in the "Oregon." Again, owing to the great size of the "Connecticut," the secondary battery of twenty guns can be widely scattered and protected by armor; whereas the effect of the smaller size of the "Oregon" on her secondary battery of twenty 6-pounders is that they are packed cheek-by-jowl and without protection, within the limited area of the superstructure amidships. A single high explosive shell properly placed would probably wipe out the whole lot!

8. On the vital question of habitability and comfort for the officers and crew, everything favors the big ship. The men can be housed well above the water line in larger quarters, and the effect of this on the *morale* of the ship's company is beyond estimate.

9. Lastly (and to our thinking, in the test of savage war, it may well prove to be more important than anything else) is the fact that the big vessel is much more difficult to sink than the small one. Should the 10,000-ton "Oregon" and the 16,000-ton "Connecticut" be torpedoed in the same spot, at the same time, with the same type and size of torpedo, it would take, broadly speaking, only six-tenths as long for the "Oregon" to sink as it would for the "Connecticut." A wound, mortal to the "Oregon," might not be so to the "Connecticut," for it is likely that the extra subdivision obtained in the large vessel would serve to keep the "Connecticut" afloat, though the other went down. So also the relative destruction of a 12-inch high explosive shell would be less on the bigger vessel, for the reason that a larger proportion of the bulk of the ship would be outside the immediate danger zone. Indeed, the same inverse ratio of 10 to 16 would apply. Then, furthermore, the gun crews being more widely separated, there would be less disablement by the bursting of a single shell. And would not the "Connecticut" have the prestige and moral effect which always goes with great size, if that size is known to be backed up with high efficiency? The "Connecticut" could pass alone without fear of attack over stretches of hostile water, through which an "Oregon" would not dare to venture.

The test is between size and numbers. We have proved that size is best; and since our country is now the wealthiest in the world, and the most generous in its expenditures, why should we not solve the problem at once and reconcile opposing theories, by adopting both, and building at once the biggest ships and, with the exception of Great Britain, the greatest number of them in the world?

ENACTMENT OF THE AMENDMENT OF UNITED STATES PATENT STATUTES.

The patent bill H. R. 17,085 was passed by the United States Senate before the expiration of the session of the Fifty-seventh Congress, and, as the bill has also received the President's approval, the amendments referred to in our last issue are now incorporated in the United States patent law.

The patent bill was prepared by the Commissioner of Patents at the request of the State Department, and it was introduced in the two houses of Congress early in the second session of the Fifty-seventh Congress; but, because of the failure of the patent committee to see the importance of the amendment, the bill was not reported until a short time ago. The amendment of our patent law in accordance with the provisions of the International Convention has cleared the field for American inventors in the foreign countries which are signatories to the International Convention, for they may now claim all the privileges of the Convention, without the fear that the courts may hold that they are not entitled to them, because of the failure of the United States to reciprocate. The United States is now extending to foreigners all the rights to which they are entitled under the treaty. The benefits of the amendments to the patent laws here and abroad, which have been made in accordance with the amended rules of the International Convention, will be claimed by many inventors who, under the old treaty and laws, were unable to file their foreign patent applications within the short time prescribed by the old regulations.

OUR AGRICULTURAL COLLEGES.

As the result of National and State co-operation, which enables the ordinary farmer to profit from the experiments of widely separated individuals interested in scientific farming, the United States stands foremost in the matter of agricultural development. Our Department of Agriculture renders the greatest service imaginable to the country; but its facilities are greatly improved by the co-operation of the different State agricultural institutions, while the farmers of each section can rely upon their special State colleges to supplement the general work of the National institution. These State agricultural colleges are quietly doing a great good in the cause of scientific agriculture and horticulture.

The Massachusetts Agricultural College is one of the foremost representatives of the typical institution devoted to practical agricultural education, and its work and studies are devoted chiefly to the training of students in modern scientific farming. The work is conducted both in the classroom and on an experimental farm. The institution is located on a farm of 400 acres at Amherst, Mass., and its buildings and land are valued at $315,000. Its annual income from the State and United States amounts to $45,000, and it is provided with a permanent endowment fund of over $350,000. There are buildings for nearly every imaginable specialty pertaining to agriculture—a chemical laboratory, botanical laboratory, plant house, creamery and dairy laboratory, veterinary buildings, barns, museum, library, and entomological laboratory and insectary.

Instruction is given by a corps of eighteen professors and assistants in chemistry, botany, agriculture, horticulture, zoology, veterinary science, mathematics, civil engineering, and similar studies. Practical work on the farm is a part of the course, and the students cultivate the whole farm and experimental orchard and nursery. There are 100 acres devoted to orchards, vineyards, and the cultivation of small fruits. One hundred and fifty acres are under cultivation with field crops, and nearly as many more acres are devoted to grass and hay for the 100 head of cattle which are kept on the farm. Considerably over a thousand men have passed through the Massachusetts Agricultural College. It is interesting to note the locations and occupations of these men. A recent census of them showed that nearly 400 are to-day engaged in agricultural pursuits, more than a score are instructors in other similar institutions, many are dead, and others have drifted into a variety of callings. The effect of the college on the agriculture of the country must prove of immeasurable value if a similar proportion of its graduates adopt farming for their life's work, performing their labors in a scientific manner such as they were taught to do at the institution.

The State agricultural and mechanical colleges which have sprung up in most of the leading agricultural States of the East and West, and many parts of the South, in recent years, have in view the training of young men for scientific and practical agriculture, and also for mechanical and manufacturing arts and sciences. They are endowed by the State in which

they are located, and also by private individuals. They are for the most part under the control of the State board of agriculture, the Governor, and other State officers; but the president of the institution and the faculty practically have all the liberty they demand in carrying out the work according to well-defined policies. Some of these State agricultural colleges are remarkably well equipped and endowed for the work they have in hand. Thus the Iowa State College has fifteen buildings, which have been erected by the State at a total cost of half a million dollars. There are nearly a thousand acres of land attached to the institution. A corps of 55 professors and nearly 600 students is engaged in study and work. All kinds of crops raised in the State of Iowa are planted and cultivated on the farm, and cattle, horses, and poultry are kept by the students. Experiments are constantly being carried on by the professors and students in agriculture, horticulture, chemistry, and general farming; and the results of these experiments are published in bulletins and papers for the benefit of the world.

The Pennsylvania State College, or "The Agricultural College of Pennsylvania," is even broader in its educational aims than the Iowa State College of Agriculture. Almost all studies from agriculture, chemistry, physics, engineering, mining, and mathematics up to philosophy, general literature, and languages are taught there. In recent years this college has steadily broadened toward a high-grade technical, scientific, and classical institution. Nevertheless, agriculture, in all its wide fields of application, is one of the chief studies emphasized at the college. A correspondence course has in late years been organized for the purpose of instructing students on farms who cannot attend the college, but who wish to avail themselves of the researches and facts obtained at it. Forestry is one of the most useful branches of work carried on at this college; and it not only trains young men to appreciate the value of cultivating orchards and woods, but also turns out practical foresters, capable of taking charge of large forests and converting them into profitable possessions, without destroying and denuding them of trees.

The Michigan State Agricultural College is another similar institution which, for more than forty years, has endeavored to help the farmers in their struggle to wrest from the soil a fair compensation for their labors. The original idea of this college was to perfect in their studies all graduates of the common school who wished to possess a complete practical and theoretic knowledge of the arts and sciences which bore directly upon agricultural and kindred pursuits. Economic zoology, meteorology, physics, veterinary science, entomology, bacteriology, chemistry, geology, and agriculture and horticulture are a few of the studies pursued. Post-graduates can pursue advanced studies in the sciences, and in the library of 20,000 volumes they can find nearly all the literature of value pertaining to their particular studies. There are some 676 acres of land attached to the college, 230 acres of which are devoted to field crops, 45 to woodland, 114 to orchards and garden, 47 to experimental fields, and 240 to forest. There is a fine arboretum, a fine botanic garden, a grass garden, and a weed garden, where a hundred or more noxious weeds are grown to show their destructive possibilities to the students. There are some 450 students at the college, and more than half of them take the full agricultural course.

The South has a good institution of this class in the Mississippi Agricultural and Mechanical College, with a faculty of some two dozen members, and a student membership of nearly 400. The college is under the management of a board of trustees, with the Governor of the State an *ex-officio* member. The students who attend this college are paid eight cents per hour for their work in the fields or orchards, which enables them to pay for a part of their living while studying.

The Kansas State College, with its 300 acres of land, buildings valued at $350,000, and a faculty of 45 professors and assistants, has become an important factor in the middle West in developing the agricultural possibilities. Agriculture, engineering, and general and household economics are taught to the students. There is a dairy, blacksmith shop, foundry, machine shop, printing office, and woodwork and painting shop connected with the college, where practical work can be followed by the students.

With agriculture as our leading industry, many of the large universities have in recent years established an agricultural course and experimental farms as a part of the regular college course. When this subject is mentioned, one turns instinctively toward Cornell University, with its admirable agricultural and forestry departments; toward the Ohio State University, with its buildings and equipments aggregating nearly $3,000,000 and with an income of $350,000; or toward the University of Wisconsin or of California. These typical universities, which have given agriculture and horticulture a prominent place in their curriculums, have sent forth annually hundreds of students to teach practical farming to new communities, which may still labor under the disadvantage of old methods and ideas of agricultural production. The Ohio State University at Columbus, Ohio, has over a thousand students, and a corps of 78 professors and assistants; but it aims to give a scientific and classical education to both young men and women. It is divided into six colleges, with one devoted to agriculture and domestic science, and another to veterinary science. Students pursuing other studies can take courses in these departments, and there are also opportunities for graduate studies in the science of agriculture. There is a well-stocked farm of 200 acres connected with the university, a fine dairy department, a large laboratory for student work in soils and crops, and a fine veterinary laboratory and operating building.

In the University of Wisconsin, with its membership rapidly approaching 2,000, and a corps of over 130 professors and assistants, there is a college of agriculture, which gives excellent courses in dairying, veterinary science, experimental farm work, entomology, scientific plant investigation, and general horticulture and agriculture. There are cheese factories, creameries, and dairies on the farm, with large green-houses for raising plants, extensive barns for cattle, and bacteriological laboratories. The college co-operates with the sixty-odd State institutes of the farmers, both in supplying literature and lecturers; and thus becomes a real and essential part of the State's chief industry.

Like the two former, the agricultural college of Cornell University, in New York, has become one of the greatest factors in stimulating and broadening the farming interests of the State and, indirectly, of the whole country, while it has contributed largely to the establishment of agriculture on a firmer and higher scientific basis than ever before in its history.

ACTION OF GELATINE UPON GLASS.

In a paper read before the Académie des Sciences M. Cailletet describes the action of gelatine upon glass and other surfaces. When a glass object is covered with a thick layer of strong glue, the latter adheres strongly when wet, but upon drying it may be detached and carries with it glass scales of different thicknesses which have been lifted from the surface. The glass which is thus treated presents a surface whose designs resemble those of frost on a window-pane, and have a decorative effect.

M. Cailletet made experiments with gelatine upon different substances, and found that tempered glass was easily attacked, as well as Iceland spar, polished marble, fluorspar and other bodies. A sample of quartz cut parallel to the axis of the crystal was covered with two layers of fish-glue; after drying it was found that the surface was attacked and showed a series of striæ which were parallel, rectilinear and ran close together, while in the case of glass the striæ were curved. When certain salts were dissolved in the gelatine, namely, those which were easily crystallized and had no action, there was produced on the glass a series of engraved designs which had a crystalline appearance. Thus a solution of strong glue containing 6 per cent of alum gave very fine designs somewhat resembling moss in appearance; other salts such as hyposulphite of soda, nitrate and chlorate of potash, will produce analogous forms.

M. Cailletet told of the strong mechanical action exerted by a layer of gelatine when drying. If a sheet of cardboard, lead or even wire-gauze is covered with a gelatine solution the surfaces are seen to curve into the form of a cylinder as the gelatine contracts. Upon thin glass the effect is striking; when a layer of strong glue is spread upon a cylindrical vessel of thin glass the effort which it exerts when drying is sufficient to break the vessel with explosion. When a plate of thick glass covered with gelatine is examined by polarized light a powerful mechanical strain is observed in the glass, and the value of this effect could no doubt be measured.

NEW ELECTROMAGNET FOR MAGNETO-OPTIC WORK.

Prof. A. Gray delivered an interesting paper before the Glasgow Section of the Institution of Electrical Engineers on March 11, on magneto-optics. He explained at the outset that the old Ruhmkorff electromagnet, though better than the permanent magnet, was incapable of giving a very intense field, a circumstance which was chiefly due to general ignorance of the theory of the magnetic circuit. Given this, however, the improved knowledge enabled more powerful magnets to be constructed, and several of these were described and illustrated on the screen. Among them was one constructed at the author's instigation for work on the properties of substances in magnetic fields at his laboratory in the University College of North Wales, Bangor. A magnet described by Mr. S. L. James in Nature (June 13, 1901) was also detailed and illustrated. On going to Glasgow, Prof. Gray decided to have a much larger magnet built for a series of researches on magneto-optic effects, somewhat similar in form to his Bangor magnet and that of Mr. James. A different arrangement for carrying the pole-pieces apart was adopted, and the cores of the upper coils were made sufficiently long to allow them to be slipped to the right and left through a distance great enough to give the length of gap required, and at the same time to accommodate the coils. The magnet was constructed by Messrs. Mavor and Coulson, and it was found that with a current of 25 amperes a field of upward of 50,000 C. G. S. units was produced and confirmed by determinations of different observers. The field was determined by putting a ring of wire round it between the faces of the poles, and then suddenly withdrawing it; the deflections produced on a standardized ballistic galvanometer having been observed, it between the faces of the poles, and then suddenly was found to be of ample power for the magneto-optic experiments. Since in the earlier experiments on the magnet it had been found impossible to obtain with pole-pieces with narrow tips so high a field intensity as at first, this raised the interesting question as to whether the poles had lost considerably their capacity for conducting lines of force; but the point was shortly to be put to the test. The author understood that dynamo builders believed that as a machine aged a greater speed was required to give the same E. M. F., and this was possibly due to deterioration of the iron, though he considered that the impaired insulation of the magnet coils was accountable for it. If any deterioration in the iron of a dynamo occurred it was more likely to occur, and that quickly, at the pole tips, and in view of the reluctance of that part of the circuit, a great deal depended for the success of such a magnet on the obtaining of the best possible iron for the conical pole-pieces.

SCIENCE NOTES.

The original map made by George Washington in 1775 of the lands on the Great Kanawha River, West Virginia, granted to him by the British government in 1763 for his services in the Braddock expedition, is now in the possession of the Library of Congress, says The National Geographic Magazine. The map is about two by five feet, and is entirely in the handwriting of Washington. The margin is filled with notes, also in Washington's handwriting, describing the boundary marks set by Washington and different features of the tract.

The coca plant, *Erythroxylon coca*, among others of medicinal value, is being experimentally cultivated in the Victoria botanical garden of the Cameroons. A firm of alkaloid makers in Germany, to whom some of the leaves were sent, found them to contain only 0.28 per cent of total alkaloid. This low yield may be attributable either to improper drying of the leaves or deterioration during the long voyage. It is suggested that it would be advisable to extract the crude alkaloid for export, unless the leaves can be carefully packed in air-tight boxes without unduly increasing their cost.

The British weather service is systematically collecting reports from the North Atlantic and Mediterranean of the temperatures observed by shipping masters. The data thus collected are to be worked up into charts showing the temperatures over marine areas between latitudes 30 deg. and 60 deg. What the practical results of this enterprise will be cannot be foretold. Much light will be thrown upon the Gulf Stream, for it will be possible to ascertain exactly where it extends. Naturally most of the information thus collected will relate to the Atlantic Ocean, for the North Pacific is not traversed so often by shipping.

In the decennial publication of the University of Chicago may be found a suggestion by Professor Michelson of a new method of determining the velocity of light. The Professor reviews previous results, contrasts astronomical, electrical and optical methods and processes. Instead of the revolving toothed wheel of Fizeau, he suggests the use of a stationary grating, and by a double reflection of light from stationary and revolving mirrors, proposes to measure the eclipses the light suffers from the gratings. Figures accompany the original article, which make the author's plan clear. He estimates that the velocity of light can be measured to a probable error of only 5 kilometers.

Dr. Ludwig Biro, the eminent Hungarian explorer and scientist, has returned to Europe with a large collection of zoological and ethnological specimens gathered in the Malay Peninsula and New Guinea, during a period of six years. So extensive and varied is his collection, that it will require several years to examine, catalogue, and classify them for the Hungarian National Museum, where they are to be exhibited. He has obtained among his zoological specimens a number of species which have been hitherto unknown to science. Dr. Biro was formerly an assistant master in a college in Hungary, but was so imbued with the desire to prosecute his studies abroad, that he sold his remarkably extensive entomological collection, numbering 60,000 specimens, to the Hungarian National Museum, to defray his Malay expenses.

THE NEW PHILADELPHIA FILTRATION SYSTEM.

BY H. D. JONES.

In the words of Consulting Engineer John W. Hill, who is installing the new filtered water system with which Philadelphia will be provided with pure water in unlimited quantities, the improvement will be the "greatest municipal advance in the history of the world, and comparable only to the renovation of the entire sewerage system of London thirty years ago." To begin with, a conduit is being hewn, cut, drilled, and blasted out of the solid rock a hundred feet beneath the surface of the Delaware River bank, and only a few feet less beneath the surface of the stream, for a distance of more than 14,000 feet. This conduit is only a small part of the general plan, which includes five one-half acre filters at lower Roxborough, eight filters at upper Roxborough, eighteen filters at Belmont, and fifty-five filters at Torresdale. In round numbers the entire system when working will have a capacity of 300,000,000 gallons of filtered water a day, more than the entire consumption of the city. The Lower Roxborough plant is intended to supply the section of the city known by that name and Manayunk; Germantown will depend for its filtered water upon the supply from the filters at Upper Roxborough; West Philadelphia will be supplied from the Belmont plant, and the older parts of the city will be furnished with pure water from the enormous plant at Torresdale.

For an explanation of how the beds are made and how the filtering of the water is done, the Torresdale plant will serve as an illustration, that being the largest plant, and all the others being built practically in the same way. The amount of ground held by the city for the Torresdale plant is 384 acres, of which something in excess of 55 acres is now being built upon, the remainder being held for operations not immediately contemplated, but which will some day be necessary when the question of enlargement is forced upon the engineers.

Perspective View of One of the Compartments of Filter Bed.

In this plant alone there are 4,450 feet of main sewers, from three and a half to eight and a half feet in diameter. These of course are for drainage, and not for the handling of sewage. There are two miles of 20, 24, and 30-inch terra-cotta pipe; 8,000 tons of cast-iron pipe from 16 to 60 inches; a million yards of excavation; 4,000 lineal feet of concrete conduit from 7½ to 10 feet in diameter; 170,000 cubic yards of concrete work; 118,000 yards of clay puddle work. Everything used in the construction except the piping is made on the spot, as is all of the temporary material, such as the wooden forms in and around which the concrete work is molded, and this in itself necessitates a manufactory that is by no means a small affair.

Each filter bed covers an area of three-quarters of an acre, net, that is exclusive of the walls and the pillars inside which hold up the roof. There are fifty-five of these filter beds at Torresdale, which, as before stated, make the plant the largest in the world. Each bed has a capacity of four and a half million gallons in a day of twenty-four hours under a "six million rate." The six million rate is the amount of water that will run through an acre of sand in twenty-four hours.

The process of filtration is of course exactly the same. Each basin is covered with a roof, the filtering material being placed in the bottom of the basin. The roof of the filter bed is 12 feet 9 inches in the clear above the floor and is supported by concrete walls which are three feet wide at the bottom and taper to 22 inches, and by piers, also of concrete, with bases 22 inches square placed at regular intervals, so that their centers are 15 feet 10 inches apart. The roof supported by these piers consists of a series of arches. The floor of the bed is made by putting down 12 inches of puddle (clay mixed with gravel in

Entrance to Filter Bed. House in which Ingoing and Outgoing Flow is Regulated.

Interior of One of the Filter Beds.—Parallel Lines Running Through Compartments on Right are the Tracks of Railroad Used to Transport Sand into the Filter Bed.

THE NEW PHILADELPHIA FILTRATION SYSTEM.

equal parts) and over this the concrete. The walls and piers are made by ramming the concrete into wooden forms, due allowance being made for contraction and expansion, while the concrete forming the roof is also put on over wooden forms in such a way that each pier is actually, and the whole chamber practically, a monolith, or single stone, the leakage through which, either in or out, may be disregarded. On the floors of the bed, in parallel lines between every two rows of piers, are laid perforated terra-cotta pipes 8 inches in diameter. These pipes, running to the center of the floor of the bed, meet there a pipe running at right angles to them, and this pipe conducts the filtered water out of the chamber.

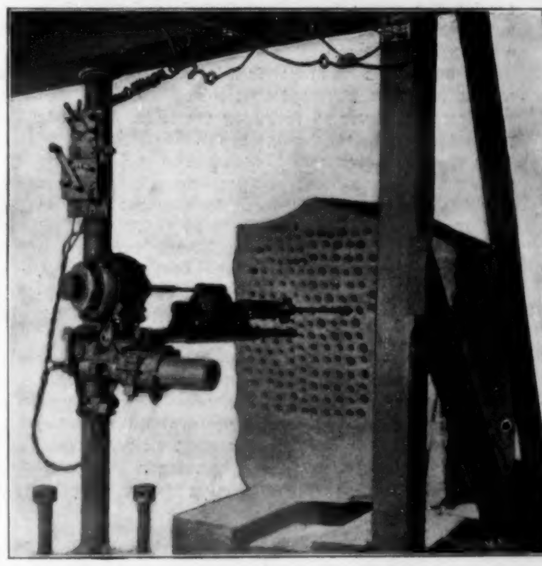
Over the perforated pipe is put broken stone or coarse gravel, the first layer being of stones the size of a walnut, to a depth of a foot. Over this is put from three to three feet and a half of sand. It is this sand which does the work of filtering. Over the roof is about two feet of earth, and such surface water as may fall on this and find its way to the concrete roof is taken up by a two-inch drain pipe.

The water to be filtered is let into the bed directly from the river through a twenty-four inch pipe; there is only one outlet for each bed. The water filters through the sand and into the perforated pipe, and thence into the pipe, which carries it out of the bed. Just outside of the bed it goes to the regulating chamber, whereby the flow of water, and consequently the rate at which it is filtered, is automatically controlled. The filtered water flowing into this chamber fills it to a point where it may flow out by passing over and into the upper end or mouth of a pipe which stands vertically in the chamber, and which is so supported on a float that its mouth is always at a given distance below the surface of the water. If the mouth is raised above the surface, as it can be of course, no water flows out; the lower it is sunk below the surface the faster the water will flow. From the regulating chamber the water flows by gravity into pipes which run along the alleys—or courts as they are called—between the batteries or sets of filter beds, and thence it finds its way to the conduit running along the west side of the plant. This conduit is practically one solid stone pipe made out of concrete, beginning with a diameter of 7½ feet and increasing to 10. It empties into the filtered water basin, which covers an area of 10½ acres and has a capacity of 50,000,000 gallons. The basin is made entirely of concrete. Its inside height in the clear is 18 feet, and its roof is supported by piers similar to those in the filter beds. The roof is covered with earth, as are those of the beds, but since the water is now filtered, no surface water is allowed to get into it, but is carried away by drainage pipes.

From the filtered water basin another solid concrete conduit 10 feet in diameter runs for a distance of 900 feet, carrying the water to a shaft that connects with a tunnel that runs to what is called Lardner's Point, three and a half miles away.

The water supplied to the filters is pumped to the preliminary filters, through which it will pass and flow by gravity to the plain sand filters. The preliminary filters contain a bed of granulated material, which may be broken trap rock or slag, varying in size from ⅜ to 3-16 of an inch and in depth about 30 inches, above which is placed a mattress of compressible material, through which the raw water flows from the bottom to the top.

In cleaning the beds it is necessary to take great care not to disturb the layers of sand. Filtered water is at first put in very gently from the under side, taking just the reverse course it has when being filtered. Once the surface of the sand is sufficiently covered with water, the rest may be again put in through the regular supply pipe. These "refill pipes" are as numerous and complete in their system as the supply pipes. They are each 16 inches in diameter. Each bed has a sand incline, by which the sand is taken out or new sand put in. This sand incline is built upon iron channel beams, which are set into the two middle rows of piers. At the apex of every other one of the arches of which the roof is formed is a manhole, which serves for light and ventilation while the bed is being cleaned. Each filter bed has to be cleaned once a month, which requires a day's work on the part of thirteen or fourteen men. For the entire system there will be needed about 400 permanent employes working as filter-bed cleaners. It is expected that the work will be finished this fall.



THE LOCKE ELECTRIC PERCUSSION ROCK DRILL.

THE LOCKE ELECTRIC ROCK DRILL.

This drill is one of the percussion type, the drilling tool having a combined reciprocating and rotary motion. In this it resembles the usual form of air drills, but being driven by electricity it has, instead of the somewhat unmanageable air tubes, simply flexible wire connections. It is essentially a ball bearing machine, is made dust and water proof, and only requires a few drops of oil at intervals of an hour or more to keep it in perfect working order. Any overheating can be readily felt, and at once reduced with a little oil. The shank or base of the drill (see figure) is made to fit the clamp or saddle generally used upon the ordinary 4½-inch column or 4½-inch arm.

The motor, which is inclosed in a spheroidal shell (at the left of figure) is directly connected by means of a hollow extension shaft, thus doing away with the usual flexible shaft of other drills. It is readily detached, and as it only weighs 95 pounds one man can carry it about, or two men can handle the whole drill without disconnecting it. The motor is a shunt wound ¾ horse power making 2,500 revolutions per minute and using 220 volts of direct current. The drill strikes the rock 300 to 350 blows per minute, and the spring which gives the forward motion of the piston has a final compression at the end of the back stroke of 720 pounds, thus giving a very high forward velocity to the piston. The drill will rarely if ever stick in the rock when crossing seams or soft spots, as the mechanism is so constructed as to have much greater power to pull the drill back than the spring has to drive it forward.

The Locke Drill Company makes specially favorable arrangements to supply duplicate parts. A number of extra parts are supplied with each drill.

The weights of the different parts of the drill are as follows: Motor, 95 pounds; drill bore, side bar, and feed screw, 53 pounds; front and back cylinders and interior mechanism, 91 pounds; total weight, 239 pounds.

Among the advantages of this drill may be mentioned that the insulated wire connections of the drill are much more easily handled and much cheaper than the air pipes of pneumatic drills. Many mining districts are now well supplied with electric power, and it is only necessary to put in rotary transformers where the current is alternating or the voltage unsuitable. Many mines however have their own electric light plant, usually furnishing direct current, and a few drills using less than one horse power each would not overload the dynamo.

THE GORTER WATER TOWER.

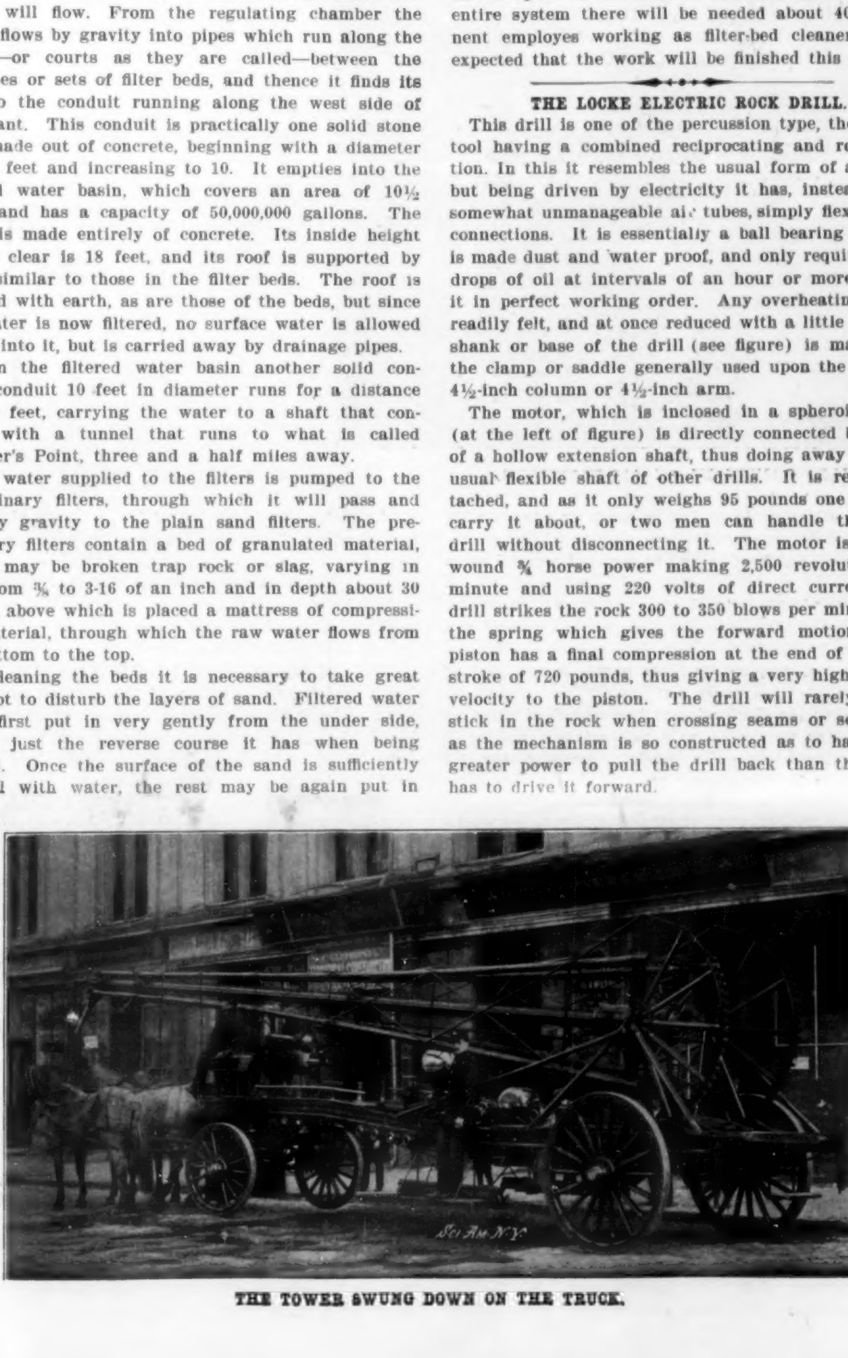
BY H. J. BENNET.

San Francisco has in service among its fire apparatus a "water tower" embodying in its design and construction some very novel features and radical departures from any other tower heretofore constructed.

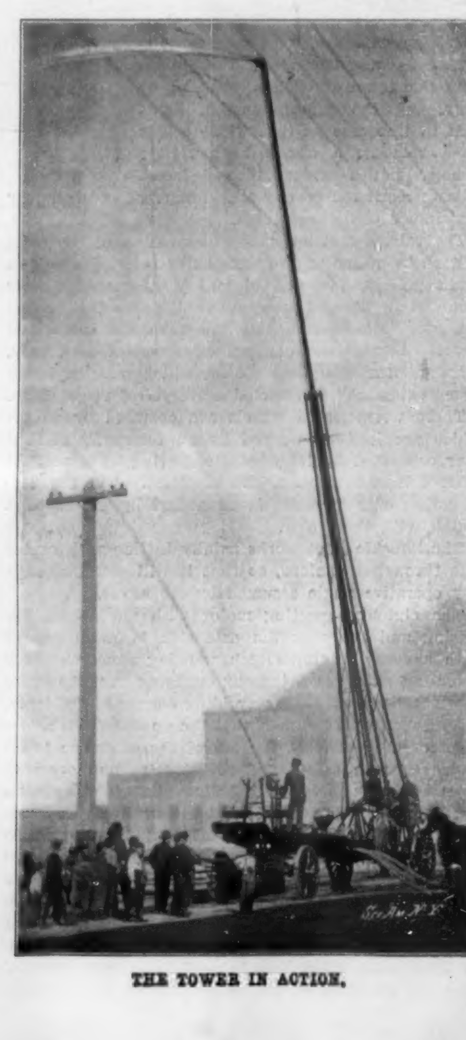
It was invented and designed by Henry H. Gorter, a mechanical engineer in the fire department of that city. This tower has fully demonstrated its superior efficiency, during its few months of service under rigid tests and at large fires, in a manner such as to attract wide attention from fire officials of various cities throughout the United States and Europe. Its construction and general features are as follows: The body frame or truck proper is of 5-inch channel steel, built on the truss principle, the rigidity being obtained by various hog braces and truss rods. The main mast is 3-inch light steel tubing, properly braced and reinforced, forming a very rigid, yet light pyramidal frame so arranged as to swing on trunnions at its lower end; said trunnions being carried on two tripod frames resting on truck proper.

The extension of mast which slides up and down through center of mast proper is of 5-inch light steel boiler tubing, reinforced by two feathers on the outside, to take up excess of spring under back pressure strain from nozzle.

The full extension of this tower is 76 feet to center of nozzle ball joint, the nozzle itself reaching 2½ feet beyond that, making this, by far, the highest water tower in service, in either the United States or the world. This tower is metallic telescopic, no hose at



THE TOWER SWUNG DOWN ON THE TRUCK.



THE TOWER IN ACTION.

all being employed. Inside the extension of mast and fastened to the base of main frame, a light four and one-half (4½ inch) inch brass tube is connected, forming a water conduit, carrying at its upper end a hydraulic packing joint, working inside mast extension and which tightens up under pressure.

This arrangement entirely obviates the accumulation of dead water in extension of mast, which in winter time might freeze and incapacitate the machine from service.

The manipulation of the tower is accomplished by a Pelton water wheel, placed on the body of the truck. This wheel is reversible, working both ways, two jets being used moving in opposite directions and controlled by a three-way valve. A lever in the hands of the fireman in charge enables him to shut off entirely, or open either jet.

The tower proper is raised by means of right and left-handed worms working segmental worm gears fastened to base of mast proper. By this means the tower is locked in all positions the moment the motor stops.

An unusually strong feature of the tower is, that it will operate at an angle of 35 degrees either way of the perpendicular and can be swung backward or forward through said angles while delivering its stream and at all pressures. To render this innovation possible, the water conduit connection between base of mast and main supply is made on the ball and socket joint principle, said joint being axially in line with the center line through trunnions of mast. When the tower is raised to an approximate vertical position, the fireman detailed for this purpose simply locks the segmental threaded connection between the main supply, previously mentioned, and ball joint of mast, by one-third of a turn. The advantage of the swinging mast is that an entire front of a building can thereby be covered, as the mast, when swinging through its entire arc oscillation of 70 degrees, will cover a frontage of no less than 90 feet.

The nozzle is at all times in a position to throw a stream clear through a building to the rear, a feat impossible when merely rotating the nozzle as in other towers. However, the nozzle on the Gorter tower also possesses a rotary movement to its vertical axis.

The second main feature is that the extension of the mast is both raised and lowered by the water motor, and can at all times be raised and lowered while the tower is in action, by which means the stream can be instantly changed from the eighth to the third story, and *vice versa*.

No tower heretofore built has or does embody this feature. Of course by raising or lowering the nozzle, the stream from this tower can be deflected up or down, but the same objection holds good in this case as that which exists when rotating a nozzle horizontally; namely, that a stream thus deflected fails to reach the rear of a building and consequently loses much of its usefulness.

The raising and lowering of extension of the mast is done by means of two test chains running over two chain pulleys, fastened to two worm-geared wheels mounted in base of mast proper. These test chains run over idlers fastened to upper head of mast and connected with base of mast extension at both ends, thereby forming endless chains, which raise or lower "mast extension" as the chains are pulled up or down.

These worm-geared wheels are operated by worms which are in turn worked by an internally meshed gear connected by intermediate gearing on a vertical shaft driven through a knuckle joint. And the continuation of said shaft is connected by means of a clutch with the motor.

The knuckle joint works axially in line with center line through trunnions, so that it will work through any operative angle assumed by the tower.

The clutch connecting motor with mechanism for raising and lowering the extension is so connected with a corresponding clutch working mechanism for operating main mast, that by engaging one, the other becomes disengaged, thus avoiding danger of accidents.

Another strong point is, that the up and down movement of the nozzle at the top of the extension is effected through a ball and socket joint and operated from below by means of a hollow shaft, and an octagonal extension in same, to which is connected a worm working a segmental gear fastened to the nozzle proper. This feature entirely eliminates the danger of mishaps caused from bursting hose. The nozzle being mechanically connected, can at all times be maintained in any desired position, as it is not dependent on the pressure to raise same as when hose is used. In latter case, when hose is used as in other towers then the elevating of the nozzle depends on the tendency which hose has to straighten out under pressure. The Gorter tower is not thus handicapped.

The truck of the tower proper carries a receiver having eight 3-inch inlets and surmounted by an air chamber, the latter being necessary to minimize excessive pumping vibration. In addition there is carried on forward part of truck a Gorter Monitor battery, also telescopic and attaining a height of ten feet from ground when fully extended, and being employed to throw a stream from a third story to basement. Diameter of battery nozzle is 3 inches, with different reducing tips when smaller jet is desired.

When working to its utmost capacity the tower will receive the water from four first-class fire engines and deliver about 4,500 gallons per minute, weighing about 37,500 pounds.

The nozzle of tower proper is 2¼ inches in diameter, and it will be understood that a nozzle of this size working on a lever 76 feet long exerts an enormous power tending to capsize the tower.

To prevent same, there is attached to top of tripod frames a swinging strut carrying at its outer end a pair of compass legs, which, in opening out form an "A" frame. Two chains fastened to truck an equal distance apart from center of tripod frame hook in two eyes movably mounted on outer end of said strut. These eyes connect with a screw, and by merely turning a small handle on outer end of strut described, can be moved in or out.

To operate this strut it is simply necessary to swing out same at right angles to truck, hook in the chains in eyes, open out compass legs, permitting them to rest on the ground, then by merely turning the handle, chains will pull out, force down strut on "A" frame, pressing same in ground, thus forming a rigid self-supporting brace. This construction avoids difficulty found in other struts or braces made to engage with the ground by means of sharp points, which, on cement or stone sidewalks and hard-paved streets, often slip.

The tower is ready to throw a stream within 90 seconds from the time of connecting up the engines, and its weight complete is about five and one-half tons, or a load easily pulled by three horses to any part of the city.

Altogether the Gorter tower has won distinction as a fire fighter unequaled as a water tower, and in it San Francisco claims a perfect machine for its splendid fire department.

Wireless Telegraphy Between Guadeloupe and Martinique.

Regular daily communication has been established between Guadeloupe and Martinique by a system of wireless telegraphy. The station in Guadeloupe is situated near Gosier lighthouse, and that in Martinique somewhere on the peninsula of La Caravelle on the east side of that island. These stations have been installed by a detachment of army engineers. Thus far only official messages between the governments of the two colonies have been exchanged. The system in use is not that of Marconi, but one devised by the French engineer corps.

In a recent number of Petermann's Mitteilungen, Dr. G. Schott gives a summary of recent observations in respect to the distribution of the surface salinity of the oceans. It appears that in the Atlantic there are two large areas, north and south of the equator, with a very high percentage of salinity, but in the Pacific there is one comparatively small area with a like percentage, south of the equator. W. Stavenhagen sketches the history and present condition of cartography in Russia, and the editor, Dr. Supan, sums up the scientific results of the German and English antarctic expeditions so far as they have been received.

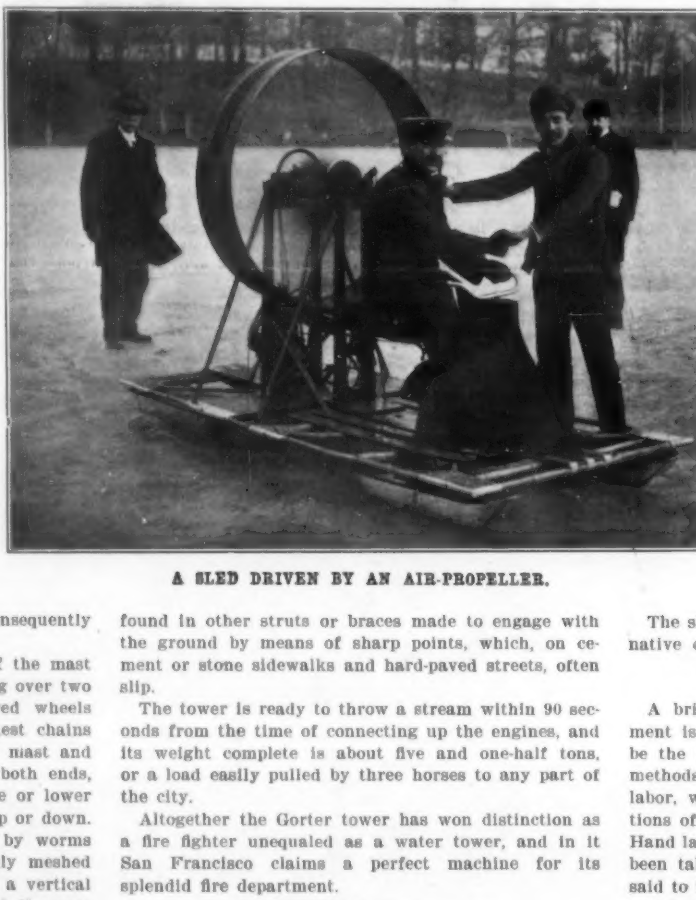
A MOTOR-DRIVEN ICE-BOAT.

An interesting experiment touching the problem of transportation on ice, is the air-sled or ice-boat driven by an air propeller, which is illustrated herewith.

The craft has a platform 12 feet in length by 4 in width, made of stout wooden slats, mounted on four big wooden skates fitted with steel blades, the front ones being so made as to respond to the steering gear, and turn, similarly to the front wheels of an automobile.

The steersman sits astride a narrow plank seat, which runs from the motor and propeller to the front end. His legs are protected behind a wind shield shaped like a plow. He guides his craft by means of an ordinary pair of bicycle handle bars, while the levers for controlling the spark, the mixture, and the clutch are within his reach. The propeller, which is 4 feet in diameter, is mounted on a frame above the motor, which is a 2¾ h. p. de Dion, connected with it by sprocket and chain. Its four blades are inclosed at the periphery by a flat band of their own width, riveted to them. This outer rim and the shape of the blades or pitch of the screw, are the vital features of the construction, and hold the secret of the successful operation of the machine. The inventor says that this mode of construction prevents the waste of any particle of air, all of it which comes in contact with the propeller being used for propulsion.

When the motor is started at slow speed and the clutch is thrown in, the propeller begins to revolve slowly, and gradually gains headway. As soon as it has attained a certain velocity of revolution, the sled starts slowly and gains speed, along with the propeller, until the maximum velocity of revolution is reached. This is about five hundred revolutions per minute.



A SLED DRIVEN BY AN AIR-PROPELLER.

There is no jerking motion, either when starting or stopping, a brake being provided that enables the operator to bring the sled to a stop in a very short distance.

Only one model has been made, but this was successfully tested, a few weeks ago, on the ice of a lake at Ridgewood, Long Island, when it carried three full-grown persons at a rate of fifteen miles an hour. The inventor believes twenty miles per hour can be attained by it, and a machine with twin propellers, operated by two 10 horse power motors, would easily make two miles a minute. At this trial of the model the weight of even six passengers did not affect its speed. It seems to run just about as fast across or into the wind, as against it; but when it goes into the wind, the number of revolutions increases and the motor runs faster.

The sled is the invention of Mr. J. Bruce Macduff, a native of Scotland, now residing in Brooklyn, N. Y.

Mechanical Brick-making.

A brickyard with an exceedingly up-to-date equipment is in operation at Dover, N. H., which is said to be the first radical departure from the time-honored methods of the ancients. By this means the item of labor, which has been one of the greatest considerations of brick yard operation, is now one of the least. Hand labor has been almost abolished, and its place has been taken by mechanical means. Thus, one man is said to take the place of fifteen or twenty.

The time required to put the bricks through all the various stages, and the great number of pieces to be handled, makes the conveyor system as now in general use unavailable for this purpose, but an adaptation of it was devised by which the material is handled in units of fifteen hundred. These are known as "stacks." The bricks are piled in these stacks after being shaped, and remain in the frames until they have passed through all the various operations. The "green" bricks are placed in these, just as they are piled in the stacks in kilns under ordinary circumstances. In this manner they are conveyed to the kilns, where they are baked. Here, by an ingenious arrangement, the bricks just entering are placed at a part of the kiln where the air striking them has been tempered by passing over the drier bricks, which have been there longer and consequently are nearer finished. This has the advantage of making a better brick, for the reason that the moist pieces are not twisted or warped out of shape by an intensely hot blast. It also represents economy of fuel. This plant has been in operation long enough to demonstrate its economies beyond all question of doubt, and it is exceedingly likely that the idea will be adopted in other parts of the country.

Correspondence.

Block Signals and Automatic Control of Trains.

To the Editor of the SCIENTIFIC AMERICAN:

It may be of interest to you to know that the Boston Elevated Railway is equipped with a safety system similar to the one you suggest in the article "How much then is a man better than a sheep?" The electric controller is shut off automatically if the motorman relaxes his hold on it, even an instant; every home or red signal is connected with a tripper which lies between the rails, and in turn hits the train pipe valve which controls the air-brake. (If the signal be at danger.) Since the road has been in operation, only one passenger has been killed, and that through his own carelessness in passing across the platform while the train was rounding a sharp curve. If a motorman through his own neglect runs by a home signal, and the tripper stops him, the first offense is loss of ten days pay. Second offense, "settle up." I have yet to hear of such an occurrence, no collision has ever taken place, and it doesn't look possible for one to occur. J. H. P.

47 Winter Street, Boston.

On the Curious Case of Regelation.

To the Editor of the SCIENTIFIC AMERICAN:

Re the "Case of Regelation" in your issue of the 21st of February last. You are right in saying that the water froze first over the surface, then over the bottom and around the periphery. The vessel having splayed sides, had not a coating of ice formed all around the receptacle, the effect of the expansion of the remainder of the water in freezing would merely have been to raise the surface ice higher as the freezing went on; but this raising of the surface ice was prevented by the adherence to it of the peripheral coating, and as the water must continue to freeze and to expand, it must either do so by bulging up the surface ice into a convex or dome-like shape, which is often noticed, and in fact always noticed under similar circumstances, or the expansion must take place by the freezing water bursting through the upper crust at its thinnest or weakest point; not, however, as you suppose, by a spurt or jet of water being projected from the interior and instantaneously frozen, and thus prevented from spreading itself over the surface, which also often happens, but by being gradually protruded through the perforated surface, congealing or freezing as it did so, and further and further protruded or pushed up or out from below; the plasticity of the ice, the while its cohesiveness causing it to adhere to and prevent it from tearing itself away from the periphery or surrounding lip of the crater of eruption.

This is not mere conjecture on my part. I have been studying the phenomenon for some years past, though in relation only to the question of plasticity of ice, which I have seen protruding from the lower end of spouts or water conductors from eaves gutters, and protruding more and more from day to day as the hydrostatic pressure from above forced the ice out further and further, until coming out of the curved end of the conductor near the sidewalk, the protruding ice was bent into a perfect semi-circle, and that of only a three-inch radius of intrados curvature, forming with the portion inside the curved end of pipe three-quarters of a complete circle.

The cohesion or adhesion of the protruding spica or horn of ice shown in your engraving to the periphery of the crater of eruption, without disruption, you would readily believe in, if like myself, and in a climate like this, you could see, as can be seen here every winter, snow (not ice) hanging from roof eaves, only a few inches in thickness and not less than from 20 to 24 inches vertically, without apparently any tendency in the overhanging portion to tear itself away from its parent sheet upon the roof.

It may be pertinent to state as explanatory of the "hydrostatic pressure" to which I allude that the phenomenon of ice plasticity is only observable during the early spring, when, while the ice in "spouts" or vertical water conductors persists below or in the shade or shadow of the morning sun, its rays have already been playing on our tinned roofs, galvanized iron eaves gutters, and metal pipings therefrom, thawing the ice within them from above, before the thaw or liquefaction of the inclosed column of ice obtains lower down; while when the sun reaches that portion of the metal conductor where the ice is, the column of ice within becomes loosened or detached from its adhesion to the metal, and allows the pressure from above to force it down and expel it gradually through the vent below; while intermittently with this hydrostatic action during the day, the effect after sunset is for the freezing to commence again from below upward, when the expansive action would again come into play from above and continue the forcing out of the ice from the lower end of the conductor.

CHARLES BAILLAIRGE, C.E.

Quebec, Canada.

The Cause of Thunder Again.

To the Editor of the SCIENTIFIC AMERICAN:

If the subject is not becoming threadbare, I would like, with your permission, to add something on "The Cause of Thunder." Your last correspondent on the subject, Mr. E. L. Bates, in your issue of February 14, does not seem to have improved very much on the "vacuum theory" taught by the "salaried and learned (?) professors of science," to whom he rather sneeringly alludes. In the experiment he describes of the electrolysis of water and subsequent explosion of the resulting oxygen and hydrogen gases, if he saw the water so produced "fall to the table" in visible drops or appreciable quantity, he must possess wonderful powers of vision (or imagination)! The amount of water produced in his experiment, all put together, would scarce suffice to make *one small drop*, and being intensely heated at the time of its formation, would be in the state of invisible vapor.

Again: it is safe to say that if enough oxygen and hydrogen to make the water of a cloudburst, such as he imagines, were to be suddenly exploded, say, above New York city, the concussion and flame produced would lay the greater part of the city in ruins; and yet this enormous energy would be barely equal to that consumed in previously decomposing an equal amount of water into these gases.

Again: the appearance due to an explosion of gases in the atmosphere would be entirely different from a flash of ordinary lightning.

Again: the lightning discharge is evidently close akin to the spark discharge of a Leyden jar or battery. This makes a loud and sharp sound under conditions where oxygen and hydrogen cannot possibly be produced and exploded. But it seems unnecessary to further multiply arguments to "explode" this theory!

Now as to the teachings of the learned (?) professors of science: Some, at least, teach that the probable cause of thunder is the violent concussion of the atmosphere along the track of the lightning flash, due to the intense heat (and consequent sudden expansion of the air and vapor) which we know to be produced by the discharge. (The Editor of the SCIENTIFIC AMERICAN clearly shows in his comments, that sudden expansion *due to heat* is the sole cause of the explosion and concussion in case of mixtures of oxygen and hydrogen.) This heat *may* make *high-pressure steam* from any water or water vapor along the track. (The writer, more than twenty years ago, advanced the view that this was the effective agent when the thunderbolt splinters a tree; but was never fully satisfied that such effects were not produced by lightning strokes even in the absence of water.) This intense heating and sudden expansion drives one layer of air against the next, almost exactly as is done by a bell or gong set into violent vibration by a blow. The layer of air next to the bell or gong is driven against the next layer, and it against the next, and so on, thus causing the "wave of condensation" which travels through the air, reaches the ear, and is perceived as sound. The sound made by the firing of a gun or any explosion can be explained in much the same way, without any reference to "air rushing into a vacuum."

Still the "vacuum theory" is by no means so absurd as your correspondent, Mr. Bates, is inclined to suppose. Did he ever perform the experiment of bursting a piece of bladder tied over the top of a cylindrical receiver on the plate of an air-pump, by exhausting the air from beneath it? Let him try this, and he will hear a sound surprisingly like "somethin' exploded."

As to why the rain so often comes down heavily and in large drops just after a heavy clap of thunder overhead, the following explanation seems probable. The small water spheres constituting the thunder cloud, heavily charged with the *same kind* of electricity (say, *positive*), mutually repel each other until the discharge of lightning takes place. Then the mutual repulsion ceases, and the agitation of the air, due in part at least to the jar or concussion of the thunder, causes many of the small spheres of water to coalesce into larger ones, which fall through the cloud, growing larger as they meet and unite with other cloud particles, and so we have the sudden downpour. It would appear that Mr. Reynolds' views are less off the right track than those of his critic.

I concur in the editor's views, as expressed in the comments on Mr. Bates' letter, except in what is said about the *pitch* of the sound indicating that the disturbance "must have a great length"—perhaps I do not catch his meaning on this point.

The length of the sound waves in thunder is probably always less than one hundred feet, and generally *much less* than this; whereas we have good reason to believe that the "length of the disturbance" (i. e., the length of the lightning flash), may be a mile or more—possibly several miles. JAMES A. LYON,

Professor of Physics and Astronomy.

Clarksville, Tenn., February 21, 1903.

The Mills Peruvian Expedition for the Study of Solar Motion.

The D. O. Mills expedition of the University of California, sent by the Lick Observatory to spend two years in studying the motion of stars in the line of sight, sailed from San Francisco for Santiago on February 28.

The object of the investigations which are to be carried on, is to throw light on the great problem of the movement through space of our solar system. The expedition is headed by W. H. Wright, assistant astronomer of Lick Observatory.

About a century ago Tobias Mayer found that in the region of Arcturus and Vega there is a slight separation of the stars. In the region of Sirius and Aldebaran, on the contrary, the stars approach. Mayer concluded that this apparent change was due to perspective, and that the sun, and the planets which revolved around it, were moving toward the region of Arcturus and Vega. Mayer's theories have been confirmed.

The direction of motion was more easily determined than the velocity. After many attempts had been made, Prof. W. W. Campbell of the Lick Observatory adopted a very ingenious method which gave valuable results.

When a luminous body which is moving away from the observer is examined in a spectroscope, the lines which appear in its spectrum will be shifted out of their true position in one direction, but are moved to the other side if the body is approaching the observer. Similar effects are observed if the body be stationary and the observer's position changes. The degrees of displacement of the lines enable one to determine the rate of motion in the line of sight.

An especially powerful spectroscope was constructed, with the aid of which the velocity of the solar system was determined. Prof. Campbell, after having studied the motions of some 283 stars, concluded that the sun was moving at the rate of 12 miles a second. A continuation of the studies has not led him to alter the conclusion which he has reached.

At Mount Hamilton, where Prof. Campbell studied solar motion, the astronomical field is comparatively limited. Many portions of the southern heavens can never be seen at all. In order, therefore, to determine with absolute accuracy the velocity of the motion of the solar system, it was necessary to study the motion of the stars in the southern hemisphere. It is for this purpose that the D. O. Mills expedition has been dispatched southward. Of the instruments which have been taken along, the most important is a reflecting telescope made by Brashear. Its aperture is over 36 inches. Its focus is 17½ feet from the concave mirror. About two years will be spent in studying the stars in the southern hemisphere.

Still Another Wireless Telegraphy System.

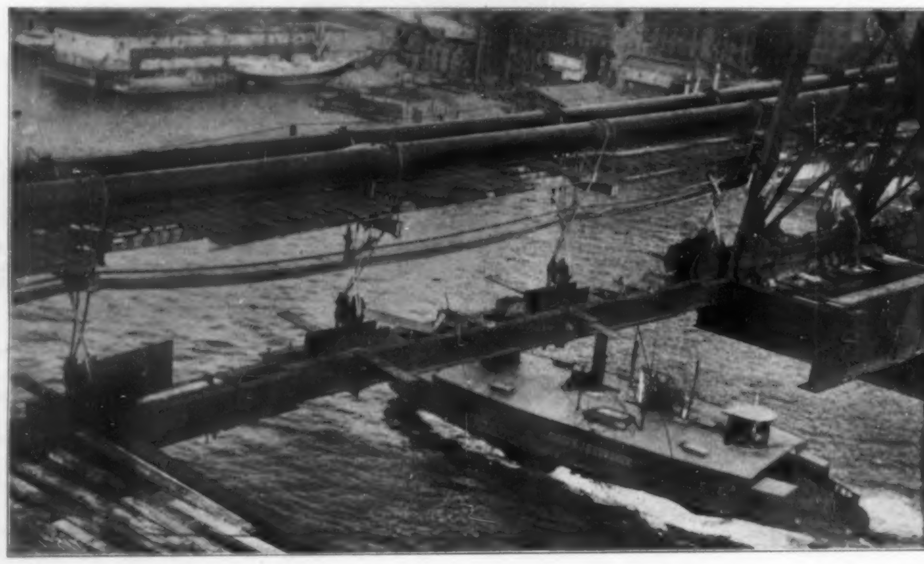
News comes from England that Sir Oliver Lodge and Dr. Alexander Muirhead, a well-known telegraphic expert, have succeeded in producing a system of wireless telegraphy for which wonderful things are promised. The meager details which have been received are anything but clear. It is said that the new coherer, which is the novel feature of the system, and which is the invention of Prof. Lodge, consists of a small steel disk rotating in light contact with a column of mercury through an oil film. A decoherer is not employed, for the Kelvin-Muirhead siphon recorder is worked upon directly, giving, it is said, signals almost equal to the best submarine telegraph work system.

The Current Supplement.

The current SUPPLEMENT, No. 1419, opens with an interesting and well-illustrated article on the French Beet Sugar Industry. Mr. M. M. Kann describes an artificial abrasive produced from steel, which is nothing more or less than crushed steel and steel emery. Dr. F. W. F. Riehl tells of a most interesting discovery of his, which is the apparent change of position of the bull's eye of a target at certain times. Mr. Wilhelm Staedel gives an account of crystallized peroxide of hydrogen, and Frederic Soddy tells something of the radio-activity of uranium. Mr. Willett M. Hays, of the United States Department of Agriculture, discourses on how some important results in plant breeding are accomplished, illustrating his text by many clear illustrations. Dr. Frederic Lee presents a paper on the scientific aspect of modern medicine. F. T. Jane offers another installment of the Naval War Game between the United States and Germany. Before the Institution of Electrical Engineers at London, Prof. R. S. Hutton and Mr. J. E. Petavel read a paper on "High Temperature Electro-Chemistry: Notes on Experimental and Technical Electric Furnaces." This paper, revised for the SCIENTIFIC AMERICAN SUPPLEMENT by Prof. Hutton himself, is published. Randolph I. Geare presents the last of his series of articles on Venomous Serpents. In the present installment he discusses snake venom, poison fangs, and treatment for snake bite.

COMPLETION OF THE FLOOR OF THE NEW EAST RIVER BRIDGE.

In January last the Pennsylvania Steel Company, who have the contract of the construction of the floor system of the new East River Bridge, received notice to commence construction. In spite of the fact that it was the depth of winter, they have made such excellent progress that last week the floor system had been built entirely across the 1,600-foot span, ready for the work of building the stiffening trusses and lateral connections. The floor proper of the bridge consists of a series of transverse plate steel girders 4½ feet in depth, which extend entirely across the floor of the bridge for its full width of 120 feet. These girders occur at each point of support of the floor system by means of vertical suspenders from the main cables above; and the distance between them is exactly 20 feet. The spaces between these girders, or floor beams as they are called, are bridged by parallel longitudinal lines of plate-steel girders of a little more than half the depth of the floor beams. There are altogether twenty-three parallel lines of these longitudinal stringers in the width of the bridge, and they extend entirely throughout the structure from anchorage to anchorage. Twenty feet in from the outside of the roadways, and lying in a vertical plane between each pair of cables, are the two great stiffening trusses, which extend the full length of the bridge. Extending between the top chords of these trusses at each panel point, and above the roadway, is a large and heavy truss which serves by means of vertical ties to support the floor beams at two intermediate points between the stiffening trusses, thus relieving the bending stress on the floor beams, and permitting them to be made shallower than would otherwise be possible.



Making the Final Connections at the Center of the 1600-foot Span. The Member Shown Suspended from the Cables is a 60-foot Section of the Bottom Chord of the Stiffening Truss.

The work that has already been completed by the contractors consists of that portion of the floor system that lies between and includes the bottom chords of the stiffening trusses, and it is made up of these two bottom chords, the floor beams, the longitudinal girders, and the series of steel bents upon which the elevated railroads will be carried. This portion of the floor was erected first, and as soon as it was connected up at the center, the bridge workmen commenced building on the external cantilever brackets which form a continuation of the floor beams and extend beyond the stiffening trusses to carry the two 20-foot roadways.

When the contractors started to build out the roadway from the towers, the main span between these towers consisted of the four great cables with steel-wire suspenders hung from them at intervals of 20 feet. At the bottom of each suspender, as they were left by the cable contractors, were four heavy steel bolts, complete with nuts at each end of the bolts. The length of the suspenders had been so graduated that the bottom of the suspender bolts was in proper relation to the curve which the floor of the bridge is designed to assume when the whole load of the completed floor system is hung on the suspenders. The process of erection consisted in first building out the bottom chords of the two stiffening trusses in sections, and bolting them to the suspender bolts mentioned above, and then putting in place and bolting up between the chords the network of floor beams and stringers. For carrying on this erection, the contractors built two large travelers, each carried on four axles 20 feet apart, with a stiff-leg

View Looking Along Axis of Bridge, Showing the Floor Between Cables Erected. Cantilever Extensions of the Floorbeams, Extending 20 Feet Beyond the Cables, will be Bolted on, Making a Total Width of Floor of 120 Feet.

Vertical View Looking Up One of the Towers. Taken Before Cables Were Strung.

The Traveler and Derrick, With Which the Erection Was Done. Preparing to Lift a 10-ton Floorbeam into Position.

COMPLETION OF THE FLOOR OF THE NEW EAST RIVER BRIDGE.

derrick at the front end of the traveler. The tracks for the latter were laid above the first line of longitudinal stringers inside the bottom chords of the truss, and as the floor framing was built up, the traveler moved forward over it. Across the top of the front bent of the traveler was a strong, transverse lattice girder, at the center of which was pivoted the 62-foot boom of the derrick, and the foot of the derrick mast. The two stiff-legs were carried back to the last bent of the traveler as shown, and when a heavy load was to be lifted, the bottom frame of the traveler was clamped to the upper flanges of the floor stringers.

The material for the floor system was brought on scows to a landing near the foot of the towers, hoisted on to a tramway, run out to the front of the base of the towers, and then hoisted to the level of the floor system by a crane which placed it on a trolley, the trolley in turn carrying it out to the erecting traveler on the bridge. The chords were built out in 60-foot sections, representing each a length of three panels, the weight of each section being 25 tons. The floor beams which were the next heaviest single load, weighed 10 tons each. As soon as the 60-foot chord lengths with the floor beams and stringers between them had been bolted up, the traveler moved forward 60 feet, and another section of the floor was built out, the operation being repeated until the two gangs of workmen met at the center of the span. The whole 1,600 feet of floor, weighing no less than 2,750 tons, was erected and bolted up in six weeks' time, a most creditable performance, and a rate of speed which, if it had been observed on some other portions of the work, would have hastened the final completion of the bridge materially. The next operation will be to erect the 50-foot stiffening trusses, the lateral carrying trusses for the floor beams, and the various details of the lateral wind truss system. Second only in importance to the erection and bolting up of the floor and truss is the work of riveting, which follows along close after the first erection. The riveting purposes an air-compressing plant has been built on the Brooklyn shore, and a 6-inch main has been laid across the bridge.

To facilitate erection, and to insure that when the final riveting up takes place the bridge will hang at its proper designed curves and level, the contractors have drawn up a blue-print showing where the material of the trusses and lateral system is to be placed along the bridge ready for erection. Every one of the many thousands of angles, posts, girders, etc., is numbered, and has its place assigned it somewhere on the great 1,600-foot span. Each piece will be laid upon the floor in the reverse order in which it is required, so that when the erectors start work there will be no time lost in hunting for particular sections, but they will be right at hand ready to be put in place, and incidentally performing the important function of loading the flexible structure to the true lines, in which it will be inflexibly held when the stiffening truss has been erected and riveted up. We are indebted to Mr. Walter T. Brown, the Resident Engineer of the Pennsylvania Steel Company at the bridge, for courtesies extended during the preparation of this article.

THE HUNTER'S POINT DRY DOCK, SAN FRANCISCO.

The Pacific Coast now has at Hunter's Point, San Francisco, the newest and one of the finest dry docks in the United States, and one of the largest and best in the world. It is the property of the San Francisco Dry Dock Company, and its construction was begun about two years ago. Its dimensions are: 750 feet long, 122 feet wide at the top and 80 feet wide at the level of the top of the keel-blocks. At high tide there is 28 feet of water over the sill of the dock, which can accommodate comfortably the largest vessel in existence. It was built by Mr. Howard Holmes.

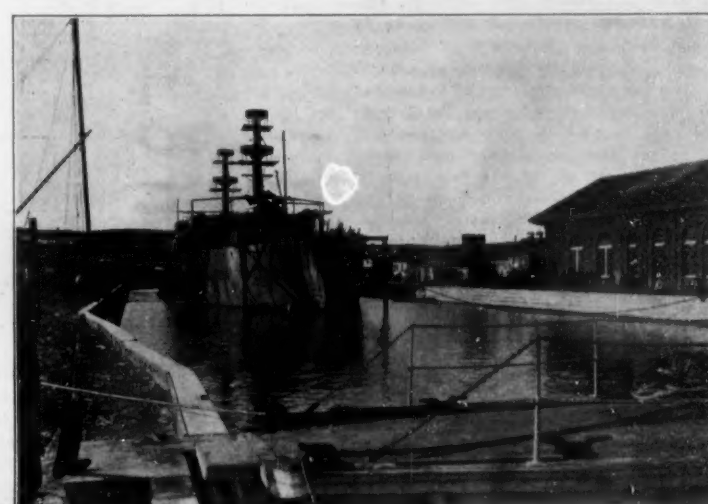
During the visit of the late President McKinley to the Pacific Coast, he was present at the launching of the United States battleship "Ohio" on May 18, 1901, at the Union Iron Works, San Francisco. On Thursday, January 29, the new dock was officially opened to receive the battleship, which is 393 feet long and 72.2 feet wide. With her crew, stores, armament, ammunition, and coal aboard, she will displace 12,440 tons.

The battleship was towed from the Union Iron Works by three tugs, and was pushed by them into the dock, the pontoon gate of which had been floated away. The gate was then placed in position and filled with water until it sank into snug contact with the rubber cushions of the sill.

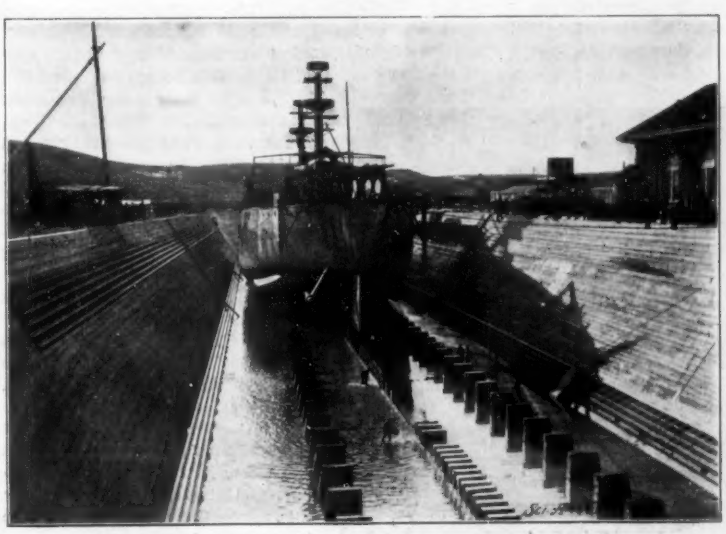
The dock engineer started the three centrifugal pumps, which together draw out 120,000 gallons of water per minute, at 12:45 P. M., and at 2:50 P. M. the battleship stood high and dry on the keel blocks. A copy of the battleship's plans had been given to the dock superintendent, and the shape of the keel and hull, together with the draught and displacement, had been carefully considered and the position of the keel-blocks calculated. The stationary blocks were set to conform as nearly as possible to the curve of the keel, and above these were placed blocks in such a position that, when the water was pumped out, the vessel would rest evenly and without strain or danger of buckling her bottom plates. The lines on which the stem and stern of the vessel were to rest were marked by stakes on either side of the dock. As the water receded and exposed the underbody of the battleship, an army of laborers, with scrapers and brushes, removed the marine growth and barnacles, so that, by the time the water was all out, the vessel was nearly clean. The "Ohio" had not been docked for ten months, but there was not so large an accumulation of barnacles upon her bottom as had been expected.

When the battleship entered the dock, there was eleven feet of water between the sill and her keel. As she rested easily in position after the water had been pumped out, there was four feet of water on each side of her at the narrowest part of the dock. Between the gate of the dock and the stern of the "Ohio" there was room enough to dock another great vessel more than 300 feet in length. The battleship received two coats of antifouling paint, her under-valves were examined, and her immersed body was put in excellent condition.

THE GATE OF THE NEW DRY DOCK AT HUNTER'S POINT, SAN FRANCISCO.



THE "OHIO" IN THE NEW DRY DOCK, VIEWED FROM THE GATE.



VIEW SHOWING GREAT LENGTH OF DOCK, SUFFICIENT FOR ANOTHER BATTLESHIP.

U. S. BATTLESHIP "OHIO" IN THE NEW DRY DOCK AT HUNTER'S POINT, AFTER THE WATER HAD BEEN PUMPED OUT.

The British Admiralty has definitely decided to adopt the French gray color as the official war paint for all the vessels in the navy. This decision has been arrived at after prolonged experiments with various tints, but French gray is the color which renders a vessel the least conspicuous and renders it a difficult target to hit. Hitherto the vessels have always been painted in three or four colors—black for the hull, white upper works above the deck level, yellow funnels, and often a red band along the water line, corresponding with the Plimsoll mark upon vessels of the mercantile marine. The new color is a mixture of black and white paints in the proportion of 11 ounces of the former to 6 pounds of the latter. The vessels of the Channel squadron are being transformed, and the Mediterranean and other fleets will be similarly treated as soon as possible. The painting of each ship costs $5,000.

THE RESTORATION OF THE FOUNDATIONS OF THE PHILÆ TEMPLES.

BY OUR LONDON CORRESPONDENT.

When the designs for the Aswan dam, situated 600 miles above Cairo, and formally opened on December 10 last, were first prepared, the contemplated high level of the water thus held back would have submerged the greater part of the ruined temples on the historic island of Philæ, which is situated just above the point where the barrage has been erected. Egyptologists and archæologists raised a great outcry against what was termed an unwarrantable act of vandalism, and the result of their agitation was that it was decided to lower the maximum level of the water to be stored up, to R. L. 106, and thus spare the temples. But even at this amended level the greater number of the temples on Philæ Island, with the solitary exception of the Temple of Isis, are covered when the reservoir is full, with water varying from two to four meters in depth.

To preserve the buildings against the head of water it was decided to underpin them and thus insure their stability, and a comprehensive exploratory survey as to the best means of accomplishing this object and its probable extent was carried out. The engineers in charge of the survey were cognizant of the fact that the Temple of Isis was founded on rock, and that the great pylons were on massive foundations sunk into the silt of the Nile to the depth of R. L. 101.5; but their knowledge of the rock depths, nature and extent of the foundations of the numerous buildings on Philæ Island was vague. A special grant was thereupon voted by the Egyptian government, to carry out a thorough exploration of the foundations, and the task was commenced in April, 1901.

Fifty-six shafts were sunk, and a number of trenches and headings were excavated, and all exposures of the foundations and levels were duly recorded.

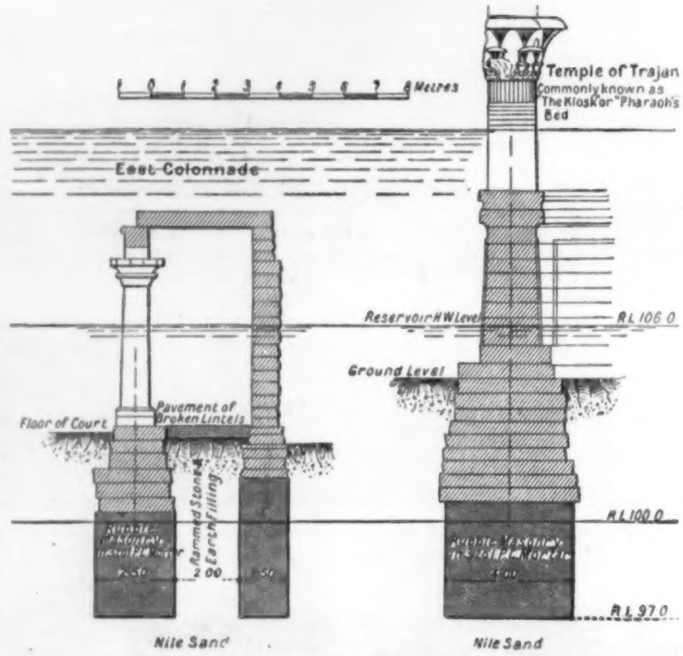
Owing to the limited knowledge possessed by the engineers as to the stability of the ruins, this survey work had to be conducted with extreme care. The trenches, headings, and shafts were very strongly timbered, and the superstructures were shored up. Approximately three months were occupied in this examination, during which time 690 cubic meters of excavations were completed. The shafts sunk varied from 1 to 1.30 meters in diameter, and were continued down for the most part to a depth of 13 meters before the bedrock was reached. When sufficient excavations had been made to supply all the information required concerning the extent of the underpinning, the excavations were untimbered and filled in.

The results of the explorations showed that the necessary underpinning to preserve the ruins would be more extensive than was at first anticipated. In fact, it practically demonstrated that nearly the whole island would have to be provided with a new foundation.

The East Colonnade rested on an almost continuous masonry foundation, approximately 2½ meters wide, and descended to the average depth of R. L. 100.60, but the wall behind it, supporting the last end of the lintels, was much shallower, reaching to only R. L. 101.60. At no point were the colonnade and wall touching the solid bedrock, the level of which varies from R. L. 91.50 at the north end to R. L. 98 at the south end. The space between the bottom of the masonry foundations of the monument and the solid bedrock was filled with Nile silt, muddy at the top but gradually passing into fine clear sand as the bedrock was approached.

The West Colonnade, however, was found to be quite differently and much more solidly constructed. Counterforts 1.80 meters thick were found to project eastward from the quay wall, at intervals of about 3 meters, and in each case they were carried down to a great depth, and in some places even to the solid bedrock. The colonnade is supported on these counterforts by stone beams, but in the majority of cases it was found that the safety of the colonnade was seriously affected, owing to the majority of the stone beams having been fractured, due to two reasons: the tremendous weight of the structure, and the gradual undermining of the ground between the counterforts.

The foundations of the Temple of Trajan, familiarly known as the "Kiosk" or "Pharaoh's bed," were found to descend to R. L. 100.60, and for the most part were 4 meters in breadth. The bedrock of the river at this point is at R. L. 90 in the front of the building, rising slowly to the maximum of R. L. 95.10. When the exploratory shafts were sunk at this point, some ancient foundation walls were unearthed, which are supposed to be the foundations of a site that was subsequently abandoned.



UNDERPINNING OF THE SUBMERGED BUILDINGS OF THE ISLAND OF PHILAE.

The Temple of Nectanbeo was found to be constructed in a curious manner. The foundation walls were carried down to the bedrock, but the superstructure is placed askew to the foundation walls, being supported upon heavy stone beams, which, however, as in the West Colonnade, had for the most part broken under the combined influences of heavy top weight and subsidence of the subsoil.

Other temples on the island were carefully examined, but they were not found to be in such a precarious and unstable condition as the foregoing, though it was eventually decided to strengthen their foundations and supports to a sufficient extent to prevent collapse. A section of the Coptic village was also revealed, and a quantity of sandstone of good quality, suitable for being utilized in the underpinning work, was found. The discovery upon this island of this masonry, which was for the most part in roughly-hewn square blocks, was of immense value, since it saved the expense, time, and trouble of conveying the requisite stone from the mainland to the island. The Egyptian government, upon the report of this exploratory survey, granted the sum of £22,000 for the work of restoring the valuable monuments, and a comprehensive scheme of underpinning was commenced. In addition it was decided to clear the whole of the Coptic village, and to carry out a thorough system of drainage and investment of the terraces. In compiling the scheme of underpinning, it was considered that the earth and sand below the existing saturation level would not subside any more.

The sectional drawings accompanying this article will afford a comprehensive idea of the scope of the operations and the principle of underpinning which was adopted throughout with slight variations according to the nature of the buildings treated. The West Colonnade was the first upon which operations were commenced. The ground was opened along the east face outside the colonnade proper, in widths corresponding to the intervals between the counterforts. Beneath the fractured stone beams, rolled steel girders 14 inches deep by 6 inches wide, and weighing 54 pounds per lineal foot, were laid in pairs, their ends resting in seats cut into the existing counterforts. These girders were surrounded with rubble masonry in 3 to 1 p. c. mortar, care being taken that they were well grouted, so that all possibility of the water gaining access to the steel, and thus corroding it, was absolutely removed. The total depth of the masonry is practically 5 feet 3 inches, so that this superstructure now rests upon a substantial and solid foundation. A similar scheme of underpinning was adopted with the Temple of Isis. With regard to "Pharaoh's bed" a much more elaborate scheme was necessary. Although old foundation walls were discovered beneath this famous ruin, it was found that they did not afford much resistance to the underpinning action constantly in progress. Beneath the original foundations of the building, which extended to R. L. 100.60, a new solid rubble masonry foundation was built right down to R. L. 97. The ground was opened inside the building. The diameter of the shaft was 1.20 meters, and it was sunk to a total depth of 7.45 meters. The shaft was well timbered up with 1½-inch boards in one meter lengths, with 9 x 3 walings and struts at intervals. By this means the engineers were able to excavate right beneath the structure. The original foundations of the temple were supported upon pitch pine head trees 12 x 8, securely wedged and packed, and side trees 10 x 7. The rubble masonry is 3 to 1 p. c. mortar, 4 meters in thickness, carried down for a depth of 3.40 meters, so that now the old building rests upon a solid masonry foundation, which rests in turn upon the Nile sand at saturation level.

A similar rubble masonry foundation was built beneath the East Colonnade and its wall, and carried down to the same level. In carrying out this part of the work the shafts were sunk between the columns and the wall behind, headings being driven both ways from the central shafts. The masonry supporting the columns is 2.50 meters thick, and that of the wall behind 1.50 meters in thickness. The space between the foundations of the columns and walls, 2 meters

COLONNADE LOOKING SOUTH. READY FOR THE LAST LENGTH OF MASONRY. THE TRENCH IS PARTLY FILLED IN AT THE FARTHER END.

in width, was filled with rammed stone and earth. The other monuments underpinned were the Mammiseum, the openings to which were sunk outside the building so as not to disturb the paved floor, the Temple of Hathor, and colonnade and rooms of the Isis forecourt, the masonry in each case being carried down to R. L. 97. Furthermore, the gateways of Hadrian and Adelphos respectively were strengthened.

The Coptic village, which comprised for the most part a collection of mud-brick dwellings in an advanced state of ruin, and constituted an eyesore, was almost entirely cleared away, and the sandstone contained therein was washed and used for the new masonry. Two Coptic churches and a few of the better houses, however, were left untouched.

During the excavations several stones and tablets freely inscribed with hieroglyphics were discovered, and these were carefully preserved for the Antiquities Department, to be subsequently deciphered.

The work was carried out by 300 native laborers and 26 Italian timber men and masons, under the supervision of four English inspectors. The work of underpinning was attended with constant and considerable danger, since the masonry of the buildings as already described had failed, owing to the undermining of the foundations, and was not able to withstand any further subsidence, such as might have ensued while the excavations were in progress. It was only by skillful shoring up and timbering, and constant vigilance, that the task was successfully completed without even an accident to either the laborers or monuments. With the extensive new foundations which have been supplied to these remaining valuable relics of the epoch of the Pharaohs, a new lease of life has been imparted to Philæ, sufficient to preserve the famous ruins indefinitely. In fact, the structures now rest upon a more substantial and solid foundation than they have at any time during their prolonged existence.

Lloyd's Wreck Returns.

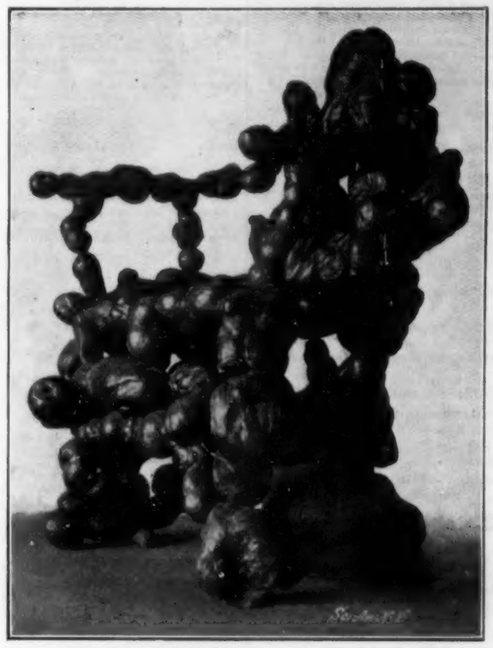
The returns of vessels totally lost, condemned, etc., during the quarter ended June 30, 1902, have just been issued by Lloyd's Register. These give particulars in reference to 45 steamers, aggregating 67,581 gross tons, and 89 sailing vessels, unitedly equal to 50,827 tons. Among the steamers the heaviest loss, 45 ships of 42,109 tons, comes under the head of "Wrecked;" while under that even more terrible heading "Missing" comes the second heaviest loss, viz., 3 ships of 10,135 tons. Collisions provide the next most serious item in these returns, 10 steamers, of 9,017 tons, figuring under this head. It is, on the other hand, satisfactory to find that no steamer was abandoned at sea in the quarter referred to. Among the sailing vessels the greatest losses were also due to wrecks, 43 ships of 20,946 tons being entered under this head alone. Four sailers, aggregating 5,258 tons, were burnt, and 10, of 6,612 tons, met their end by collision, while 6, of 5,105 tons, are reported missing. In apportioning the losses it is to be observed that the French nation had the lowest ratio in regard to their steamers, their figures being 1 ship of 559 gross tons, or 0.05 per cent of their total steam tonnage. The British Colonies were the worst sufferers in this class, their 4 steamers, of 4,332 tons, representing 0.57 per cent of their tonnage. The losses of British-owned steamers were 16 in number, their tonnage, 24,593 gross, equaling 0.19 per cent of our holding. In the matter of sailing vessels, France was also the most favored nation, her 7 sailers, of 1,405 tons, which appear in these returns representing but 0.34 per cent of her holding. The heaviest losers were the Dutch with 3.24 per cent of their total. Of British sailing tonnage exactly one-half per cent was lost, this being made up of 7 ships and 7,736 tons gross.

New French Submarine Boat.

The French Admiralty have decided upon the construction of a new submarine boat which will exceed in dimensions and displacement any yet attempted. Hitherto the largest submarine in that navy has been the "Gustave Zédé," of 266 tons, but this new vessel is to be of 350 tons. It will measure 160 feet 9 inches in length by approximately 9 feet draught. The boat will be driven by a single screw, and will have a surface speed of 11 knots. The torpedo armament will comprise four tubes. It is estimated that the cost of this vessel will amount of $250,000, which is about a third more than the cost of the most expensive submarine yet built for the French navy. It is intended to be an offensive arm, being sufficiently large to attack an enemy's ports, and to cruise along the commercial routes.

AN ARMCHAIR FORMED BY NATURAL GROWTH.

The armchair pictured in the accompanying illustration may be said to have partly grown out of the ground, although its shape was furnished by twisting and turning a vine out of which most of its framework was formed. It was brought to the United States by a sea captain who saw it in a Korean city. The chair is studded or ornamented with seeds of the gingko tree of various sizes, which have actually grown to the fiber of the vine. A Korean gardener, familiar with the adhesiveness of the seed, took



AN ARMCHAIR FORMED BY NATURAL GROWTH.

a native vine, noted for its toughness, and rudely made it into the form of a chair, holding it in place with branches of small trees. The seeds fresh from the tree were bound to the vine until they had firmly fastened themselves to it, the vine being allowed to grow in the meantime. After the seeds and boughs had become attached, the vine was cut from the roots, and this natural chair exposed to the sunlight until the sap had dried from the fiber and all of the material had hardened into a substance as solid as oak. It was then polished until its surface glistened like mahogany. Although but three feet four inches in height and twenty-five inches in width, the weight of this curiosity is over a hundred pounds, on account of the hardness of the material of which it is composed.

The armchair may well be regarded as a striking example of the gardening skill of the Far East.

THE LARGEST FINBACK WHALE.

BY WALTER L. BEASLEY.

The American Museum of Natural History has recently secured for its department of mammalogy a mighty leviathan of the deep, in the shape of a huge female finback whale, considered the largest specimen so far obtained, as it measures 68½ feet in length. The full-grown right whale averages from 45 to 50 feet in length only. This new specimen is a noteworthy contribution to science, and when mounted will form a striking exhibit of marine life seldom seen save by whalers and voyagers in the Arctic regions. The great creature was found stranded on the beach near Forked River, N. J., the latter part of November. Before the body came ashore it was first sighted a mile or so out on the shoals by the lookout of the life-saving station, from which point it appeared like an overturned schooner or craft of some sort. Acting on this supposition the life-savers launched their boat and pulled out to the assistance of a supposed wreck. On a near approach they discovered the true nature of the object, which was the great carcass of a dead whale. The pulling strength of the combined crew of ten men was not equal to moving this large, weighty animal from its stranded position, so all efforts in this direction were abandoned. The next day the heavy body was gradually pounded and pushed ashore by the incoming waves. On learning the news, Director H. C. Bumpus, Curator of the Department of Invertebrate Zoology, recognizing this as a favorable opportunity for securing a rare and splendid specimen, immediately sent Mr. George H. Sherwood, his assistant, and Mr. Figgins to investigate, and secure the body, if possible. Being first on the spot, they captured the prize ahead of other institutions. A number of local fishermen, however, had in the meantime laid claim to the big whale, but were induced to part with the same for a money consideration. A baby whale 16 feet long was also found near by.

The caudal fin or tail of the large whale measured 12 feet 4 inches from tip to tip, the body was 30 feet in circumference, and its estimated weight was about 75 tons. The length of the ponderous lower jaw was 14 feet 7 inches, and its open mouth could have more than taken in an average-sized horse. Her spacious interior, including mouth space, would more than shelter fifty men.

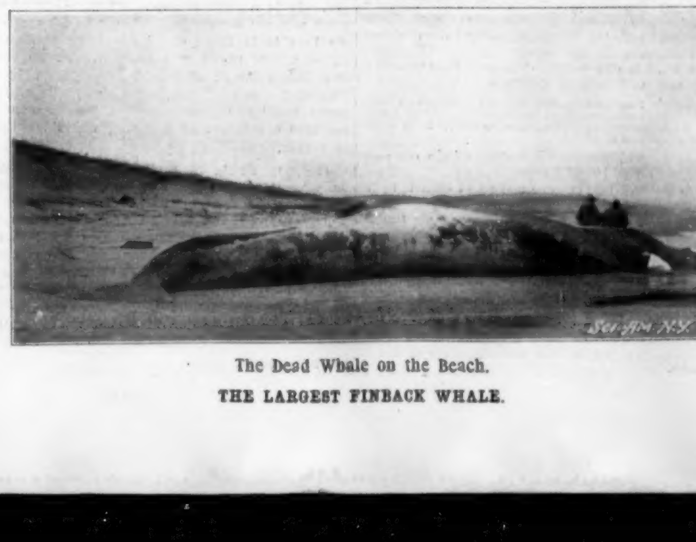
The specimen belongs to the group of whales known as genus Balænoptera, which has a world-wide distribution. This particular species is named finner or finback by the whalers, who seldom hunt it, owing to the little amount of blubber and the small-sized whalebone it carries.

There were 375 plates two feet long on each side of the upper jaw of the whale. The right whale, the one regularly pursued for commercial purposes, has whalebone 12 feet long, and 25 to 50 barrels of blubber oil.

The color of the whale was slaty blue on the back, and white with some blue markings below. There were some eighty longitudinal folds and stripes on the ventral surface of the skin. The two bodies, after the measurements were taken, were buried in the sand to preserve their skeletons until spring, when they will be unearthed and taken to the museum for mounting in the near future.

The whale is highly prized by scientists for exhibition purposes, from the fact that it is one of the best examples known illustrating the influence of environment in the modification of structure. They are considered as descendants of terrestrial mammals which have assumed an aquatic existence—a change which has brought about very remarkable modifications in the structure of the animals. Some organs have become highly specialized, while others have completely degenerated. Teeth, for instance, which are a characteristic feature of land mammals, are entirely lacking in the adult finback, their place being taken in part by the whalebone. The fore limbs have ceased to be appendages of locomotion, and have become mainly balancing organs, and they still retain the structural plan of the mammalian fore limbs. The external fish-like form is perfectly adapted for swimming through the water, and the tail is not placed as in fishes, but horizontally. The hind limbs have disappeared entirely externally, and are represented by the rudiments of hind legs, which are found buried deep in the interior of the animal. These serve no practical purpose, but they serve to indicate its former life and habits as a land mammal and to show in a striking way the effect of environment.

Cutting Up the Whale for the Whalebone



The Dead Whale on the Beach.

THE LARGEST FINBACK WHALE.

RECENTLY PATENTED INVENTIONS.

Agricultural Implements.

HAY-STACKER DRUM.—P. E. Sneer, Ellensburg, Wash. This drum, which is designed for use on hay-stackers, increases the motion of the fork without adding to the speed of the horse or other power, and also furnishes the greatest amount of power when most needed, and the greatest speed when most needed.

MOTOR-OPERATED AGRICULTURAL MACHINE.—D. Lubin, New York, N. Y. The patent covers a machine with a motor-operated mechanism, whereby digging devices are forced into the ground and then the machine moved forward one step as the diggers are lifted with the earth and breaking devices rapidly operated to finely pulverize the lifted earth.

AGRICULTURAL MACHINE.—D. Lubin, New York, N. Y. Two patents have been granted to Mr. Lubin for inventions under this heading. The first machine is of the class operated by a steam or other motor, and it comprises a rotary digging-tool with means operated by the motor for moving the vehicle forward at predetermined distances to rotate the tool and at the same time cause it to gradually enter the ground to the desired depth. The second machine is of the class in which a motor mounted on a wheeled vehicle alternately operates a ground digging or breaking tool and moves the vehicle a short distance for the next operation of the tool, the object being to provide a machine so made as to automatically change the gear connections to cause the different movements or operations.

POWER-OPERATED AGRICULTURAL IMPLEMENT.—D. Lubin, New York, N. Y. The object of this invention is to have the implement operated by steam or other motive agent in such manner as to alternately move the device and operate the ground-digging tool or tools by means of which the ground will be uniformly operated upon, finely pulverized, and prepared for planting or seeding.

Miscellaneous Inventions.

BEDSTEAD POST AND RAIL JOINT-COUPLING.—A. W. Busby, Milwaukee, Wis. A novel, simple and strong dovetail connection has been invented by Mr. Busby, which is especially adapted for joining the rails and bed posts of wooden or metal bedsteads. The device may be easily disconnected when desired. The angle-iron side rails may with this connection be so secured to the bed post as to dispose either the outer or inner surfaces of the rail uppermost.

SHOE-TREE.—M. Hayes, New York, N. Y. Means for expanding and re-shaping boots and shoes to prevent them from being crushed or wrinkled while not in use, is provided in this invention. The construction of the tree is simple and so arranged that it may be easily manipulated and inserted in the shoe.

BADGE.—G. H. Brooks, Louisville, Ky. The badge has a fastening formed of a spring wire having one end constructed as a hook and the other as the pin proper, the fastening being inserted through holes in the backing. The hook is provided with a shank which holds it rigidly in place, projecting on the face of the backing.

DISPLAY-RACK.—G. A. Weeks, Sheldon, Ill. Improvements in devices for exhibiting lace curtains, portieres, wall paper, dress goods, and other articles, are provided in this invention. Provision is made for bringing any desired article into view and also a suitable cover is provided whereby dust will be excluded from the articles to be exhibited.

DISINFECTANT-DISTRIBUTING DEVICE.—S. Hesketh, Auckland, N. Z. A device for distributing disinfectant material is provided in this invention. The device may be either portable or stationary and is arranged to constantly feed the disinfectant material at desired strength and in desired quantity, to a pivoted self-emptying receptacle, which, when discharging material from one compartment will present another compartment to be filled from the source of supply.

GATE.—F. F. Jackson, Wayne Township, Wayne County, Ind. The gate is more especially designed for use on farms, driveways and other places. The construction permits convenient opening or closing of the gate by a person on foot, in a wagon or on horseback. For the passage of small animals such as sheep and swine the gate is raised bodily without being opened.

ANNULAR TANK FOR LIQUIDS.—O. Intze, Aix-la-Chapelle, Germany. The principal difficulty attending the construction of large tanks of cylindrical form consists in the connection of the bed or bottom of the tank with the lower parts of the cylindrical walls and in the construction of a supporting structure, capable of transmitting a heavy load in an advantageous manner onto the supports. The present invention provides new means for overcoming these difficulties.

BRICK.—J. B. Dunlap, Tonkawa, Okla. Ty. Mr. Dunlap is the inventor of a novel composition of brick or building blocks, to be used for all purposes, either above or below ground, for which bricks are ordinarily employed. The brick is composed of sand and certain chemical binder ingredients, combined in a new manner.

LUBRICANT FOR WOOL AND PROCESS OF MAKING SAME.—G. B. Holden, Lowell, Mass. The underlying idea of the invention is to cause wool to run smoothly through the machinery used in operating the same during the process of manufacture, and also to soften the wool and render it pliable. Mr. Holden has invented an improved lubricant which will accomplish this result.

Note.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

Business and Personal Wants.

READ THIS COLUMN CAREFULLY.—You will find inquiries for certain classes of articles numbered in consecutive order. If you manufacture these goods write us at once and we will send you the name and address of the party desiring the information. **In every case it is necessary to give the number of the inquiry.**
MUNN & CO.

Inquiry No. 3889.—For dealers in the different parts of suspenders.

Inquiry No. 3890.—For a second-hand Becker vertical milling machine.

Inquiry No. 3891.—For parties to manufacture a suitable trophy for a public gift representing Indian corn.

Inquiry No. 3892.—For makers of steam turbine engines of 50 horse power.

Inquiry No. 3893.—For makers of metalophones.

Inquiry No. 3894.—For machines for folding and stitching at the same time.

Inquiry No. 3895.—For trolley tracks for overhead hoisting for use in warehouses for piling up heavy cases.

Inquiry No. 3896.—For a practical ice plant of capacity 50 to 100 lbs. a day, of a small cooling plant for reducing the temperature to 40 or 50 degrees.

Inquiry No. 3897.—For a speed and time recorder to be attached to an automobile or other vehicle.

Inquiry No. 3898.—For a machine for grinding or pulverizing hard substances.

Inquiry No. 3899.—For makers of portable boring bars.

Inquiry No. 3900.—For manufacturers of accordion pleating machines.

Inquiry No. 3901.—For the manufacturers of the Coats sheep shearing machine.

Inquiry No. 3902.—For importers and makers of sewing needles.

Inquiry No. 3903.—For a machine for testing lubricating grease.

Inquiry No. 3904.—For a pulley-turning lathe which will finish a pulley complete.

Inquiry No. 3905.—For manufacturers of steam engines.

Inquiry No. 3906.—For machines for picking cotton from the stalk in the field.

Inquiry No. 3907.—For makers of electric floor planers.

Inquiry No. 3908.—Wanted to correspond with parties prepared to supply a machine for cutting washers or gaskets directly from a hose as the hose is fed into the cutting machine.

Inquiry No. 3909.—For makers of the one man elevator which is run by water.

Inquiry No. 3910.—For makers of electric lighting machinery.

Inquiry No. 3911.—For the best motor freight carriers run by electricity.

Inquiry No. 3912.—For makers of the very lightest engine possible, of 2 or 3 horse power, such as for aerial machines.

Inquiry No. 3913.—For a wire-tapering machine.

Inquiry No. 3914.—For machinery for making flour from bananas.

Inquiry No. 3915.—For dealers in presses and dies for making mosaic tiles and artificial stone.

Inquiry No. 3916.—For manufacturers of decorticators.

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

Buyers wishing to purchase any article not advertised in our columns will be furnished with addresses of houses manufacturing or carrying the same.

Special Written Information on matters of personal rather than general interest cannot be expected without remuneration.

Scientific American Supplements referred to may be had at the office. Price 10 cents each.

Books referred to promptly supplied on receipt of price.

Minerals sent for examination should be distinctly marked or labeled.

(8869) W. J. C. wishes to know how to remove indelible ink marking from clothing. A. Indelible inks are of such variable character that it is quite impossible to reply. Many of these inks have nitrate of silver as a basis; in this case, a solution of hyposulphite of soda might help. Some other inks might possibly be bleached out with javelle water and weak muriatic acid; this can be used only in white goods, as most dyes would be destroyed. Possibly also a solution of sulphurous acid might be of service.

(8870) R. D. H. asks for a recipe for making (on a small scale) a varnish which will restore to shabby rubber boots and shoes a gloss such as is imparted by the manufacturers in the first instance. A. Digest 1 part of shellac with 10 parts of strong aqua ammonia until thoroughly dissolved.

(8871) C. A. asks: Can you send me a formula for making condensed milk? A. In general, condensed milk is made by evaporating in vacuum pans to about one-quarter of the original volume, and then adding 25 per cent to 30 per cent of cane sugar.

(8872) G. R. asks: 1. If there was a hole straight through the earth, and you were to drop some heavy object into it, how far would it go? A. If there was a hole through the earth, a ball dropped into the hole would fall as far beyond the center of the earth as it had fallen before it reached the center, if also we do not consider the resistance of the air. 2. Does a traction engine pull on the same principle as a horse, or can it pull more with a longer hitch? A. A traction engine pulls exactly as a horse pulls, or as any other power pulls.

(8873) J. G. H. asks: I wish to raise water 60 feet with an air pump, for domestic purposes. 1. Is it practicable? 2. If so, what should be the relative sizes of the air and water pipes? 3. What is the best type of air hand compression pump to do the work? 4. Would a two-cylinder or double pump, one cylinder a suction pump for water, the other an air compression pump, be practicable? A. There is no actual economy in raising water 60 feet with air compressed by hand. There is great loss of labor on the compressed air by its discharge to refill the tank with water in using the tank system. The air lift system requires a well as deep below the water as the lift is above it. We advise that a combination air and water pump, such as you suggest, cannot be made practicable.

(8874) A. P. A. asks: A dam is 10 feet high and 10 feet wide. A claims that with 10 feet of water on one side and 7 feet on the other, that there is more pressure on the whole dam than there is when there is 7 feet on one side and none on the other. B claims the opposite. A. The absolute pressure on the dam is due to the difference in the total pressures at the level of the water on each side. Thus the total pressure at 10 feet minus the total back pressure at 7 feet is less than the total pressure of 7 feet on one side only. We make the mean pressure per foot at 10 feet 309 pounds, and the mean pressure at 7 feet 203 pounds, and 309 — 203 = 106 mean pressure, as against 203 pounds for the mean pressure at 7 feet. B is correct.

(8875) G. A. D. writes: I have been watching your paper for some information about the new copper goods put on the market called "Royal" copper or "Olympia" copper. It is a dark color, and it is claimed to wear without scratching. Will you please tell me how it is done, or if you have published it, in which paper you have it. A. To produce this color on copper, either dip in a solution of 2 drachms of antimony sulphide and 1 ounce pearl ash in one pint of water, or boil for fifteen minutes in a strong water solution of tartar.

(8876) J. A. S. writes: Can you tell me or put me in the way of finding out how much a tall chimney made of brick will sway, if it will sway at all? I do not know how to look for the information, and I want to be acquainted with the condition for personal satisfaction. A. Tall chimneys that are small in size sway in strong winds so much as to be easily observed and measured; 6 to 8 inches from the center is not uncommon with very tall factory chimneys. Bricks and mortar are elastic.

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